DOCUMENT RESUME

ED 235 919 PS 013 938

AUTHOR Ralston, Goldie T.
TITLE An Approach to Improve Third Grade Children's Ability to Solve Addition and Subtraction Verbal Word Problems.
PUB DATE Oct 82
NOTE 72p.; Extended Practicum Report, Nova University, October, 1982.
PUB TYPE Dissertations/Theses - Practicum Papers (043)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Addition; Classroom Research; *Elementary School Students; Grade 3; Intervention; Pretests Posttests; Primary Education; *Problem Solving; *Student Improvement; *Subtraction; *Workbooks

ABSTRACT

This practicum was designed to improve and increase the problem-solving skills of third-grade students. Using a specially designed 20-item test consisting of mathematical word problems, a preassessment was made of the addition and subtraction skills of 843 third-grade students from high, middle, and low socioeconomic levels in four Florida counties. An error analysis revealed problems in two major skill areas: (1) subtrahend-minuend order of mention in subtraction word problems, and (2) labeling. Further analysis of the data revealed a positive correlation between high socioeconomic level and number order, labeling, computation, and process skills. However, no correlation existed between socioeconomic level and the percentage of perceptual errors made by third-grade students. An average of 40 percent of students scored computational errors in three-digit subtraction with zero; 23 percent made computational errors in two-digit subtraction with zero. The "Addition and Subtraction Word Problem Workbook for the Primary Grades," designed to remediate the two problem skill areas, was employed over a 4-month period with three third-grade classes. As compared with their pretest performances, the 67 members of the experimental group and the 48 members of the control group on the average reduced their number order errors by 16 and 5 percent, respectively. There was a 27 percent reduction of labeling errors in the experimental group, as compared with a 10 percent reduction in the control group. (Author/RH)

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An Approach to Improve Third Grade Children's Ability to Solve Addition and Subtraction Verbal Word Problems

Extended Practicum Submitted to the Faculty of the
Early Childhood Education Program
in Candidacy for the Degree of
Doctor of Education

By
Goldie T. Ralston

Nova University
Cluster VI

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October, 1982

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ABSTRACT

This practicum was designed to improve and increase the problem-solving skills of Third Grade students.

Using a 20 Written Verbal Word Problem Pre-Test, designed by the Writer, a preassessment was made of the problem-solving skills in addition and subtraction verbal word problems of 843 Third Grade students from High, Middle and Low socio-economic levels in four counties in the State of Florida.

An Error Analysis revealed two major problem skill areas:
(1) Subtrahend-Minuend Order of Mention in Subtraction Word Problems
(2) Labeling.

Further analysis of the data revealed a positive correlation between High socio-economic level and Number Order, Labeling, Computation, and Process skills. However, no correlation existed between socio-economic level and the percentage of perceptual errors involving numbers made by Third Grade students.

Also, an average of 40% of all the Third Grade students scored computational errors in 3 digit Subtraction with 0; 23% made computational errors with 2 digit Subtraction with 0.

An Addition and Subtraction Word Problem Workbook for the Primary Grades, designed by the Writer to remediate the two problem skill areas of Subtrahend-Minuend Order of Mention and Labeling, was implemented over a four-month period with three Third Grade classes.

On the Post-test, compared to the Pre-test, the Experimental Group (N=67) and the Control Group (N=48) reduced their average percent of Number Order errors by 16% and 5%, respectively. Similarly, there was a 27% reduction of Labeling errors in the Experimental Group, compared to 10% in the Control Group.

Results of this study strongly suggest the need for intervention in the early grades with improved instructional materials and methods, to raise student achievement in solving written verbal word problems.

ACKNOWLEDGEMENTS

I WISH TO ACKNOWLEDGE WITH SINCERE GRATITUDE THE ENCOURAGEMENT AND GUIDANCE FROM DR. POLLY PETERSON, MY PRACTICUM ADVISOR, DR. POLLY EBBS AND DR. PAUL WESSEN OF NOVA UNIVERSITY.

MANY THANKS TO FELLOW MEMBERS OF CLUSTER VI - PAUL BESSETTE, RICHARD HUGHES, SUZANNE ROMANOFF AND KEN WEST FOR THEIR ASSISTANCE.

I ALSO WISH TO THANK BETTYE EVERETT, JO-ANN MILLER AND BETTY STULTZ-GLASSER - MY COLLEAGUES AT SOUTH MIAMI HEIGHTS ELEMENTARY SCHOOL FOR MANY MONTHS OF COOPERATION DURING THE WORKBOOK PROGRAM.

MY DEEP APPRECIATION IS EXTENDED TO MICKEY KOHNKE FOR HER EFFORTS IN ST. JOHN'S COUNTY, FLORIDA.

A SINCERE "THANK YOU" TO JULIO IBARRA OF FLORIDA INTERNATIONAL UNIVERSITY AND SHELLY SLEPION OF THE UNIVERSITY OF MIAMI FOR THEIR COMPUTER TECHNOLOGICAL ASSISTANCE WITH THE RESEARCH RESULTS.

AND - A SPECIAL "BOUQUET" TO MY DAUGHTER ROSALIND, FOR MANY HOURS OF DEDICATED TYPING.

DEDICATION

This study is dedicated to
my husband Lew
and daughter Rosalind Paula
for inspiration, support and
many sacrifices.

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CHAPTER ONE

INTRODUCTION

A. Writer's Role, Responsibilities, and Work Setting

The Writer is a Learning Disabilities Resource Teacher at South Miami Heights Elementary School. Professional responsibilities include writing and implementing Individual Educational Prescriptions (IEP's), planning Behavior Modification Programs, Pre- and Post-testing of L.D. Students, Consultations with classroom teachers, special school personnel, administrators and parents, plus other related activities. The Writer has been employed in this capacity for five years.

Prior to her current position, the Writer had been employed in Clinical Reading and Learning Disability programs in Miami elementary schools for 15 years. In this clinical role, she had observed that Written Verbal Word Problems have caused difficulties for both students and classroom teachers alike at all grade levels.

For the purpose of this study, a Written Verbal Word Problem is defined as: A word description of a situation that must be read; and the correct process or processes are not stated within the problem to the problem solver. They are also known as story problems, sentence problems or work problems.

B. Description of Community Including Socio-Economic Factors.

South Miami Heights Elementary School is located in South Miami, Florida. It has a Grade Organization of Kindergarten through Sixth Grade. The school is located in a residential area where the majority of the 887 students live in private houses. The socio-economic characteristics of the surrounding school area range from predominantly "Blue Collar" workers (90%) to "White Collar" workers (10%). It is estimated that 10% of the parents have some college education. As of June 1981, approximately 30% of the pupil population was Anglo American, 32% Black and 38% Hispanic. These percentages reflect the ethnic background of the approximately 120 Third Grade students involved in this study.

CHAPTER II
STUDY OF THE PROBLEM

A. Description of the Problem Situation.

There has been little Faculty Turnover over the years at South Miami Heights Elementary School. During the 1981-82 school year, when this practicum was implemented, 31% of the instructional staff had a Masters degree or higher. Faculty Experience at the school boasted 10 average years teaching in Florida. In recent years there has been an attempt to reduce the class size in Grades K-3. However, the continuing influx of Hispanic and Black families into the community, and a critical shortage of classroom space has increased the average Third Grade class size to 27. Since budgetary restrictions prohibit the hiring of an aide, teachers have difficulties implementing programs that require an individualized approach to instruction. Despite these problems, in the Dade County Public Schools, (DCPS), Third Grade students are expected to master many skill areas in mathematics, as listed in the 1980-81 Balanced Curriculum (see Appendix 1).

Classroom teachers were concerned because 1980-81 Stanford Achievement Test scores in Math Concepts declined in Grades 1, 3, 4, 5 over the preceding year, 1979-80 (see Appendix 2). Interviews with teachers revealed that many children were using rote memorization and rote programmed procedures in their mathematical calculations, especially when solving written subtraction word problems.

IN THESE WRITTEN SUBTRACTION WORD PROBLEMS, THIRD GRADE AS WELL AS UPPER GRADE CHILDREN WOULD AUTOMATICALLY SEIZE UPON THE FIRST NUMBER MENTIONED IN THE WORD PROBLEM AND ATTEMPT TO SUBTRACT THE SECOND NUMBER. IF THE FIRST NUMBER MENTIONED WAS LARGER THAN THE SECOND NUMBER, THE STUDENT COULD SOLVE THE EQUATION, SUCH AS 9-2=7. IF THE FIRST NUMBER IN THE WORD PROBLEM WAS SMALLER, AND THE LARGER NUMBER FOLLOWED, SUCH AS:

JACK ATE 2 GUMBALLS.
THE BOX HAD 9 GUMBALLS.
HOW MANY GUMBALLS WERE LEFT?

MANY CHILDREN, WITHOUT ANALYZING THE NUMBERS, WOULD ROUTINELY ATTEMPT TO SOLVE THE PROBLEM WITH THE FOLLOWING EQUATION: 2-9=? OR $\begin{array}{r} 2 \\ -9 \\ \hline ? \end{array}$. WITH THIS INCORRECT EQUATION, THE CHILD MIGHT STILL ARRIVE AT THE CORRECT ANSWER, BECAUSE NUMBERS LESS THAN 10 ARE EASY TO CONCEPTUALIZE, BY COUNTING FINGERS OR OTHER CONCRETE OBJECTS. SINCE IT IS DIFFICULT FOR YOUNG CHILDREN TO CONCEPTUALIZE LARGE NUMBERS, SUBTRACTION WORD PROBLEMS WITH 2 AND 3 DIGIT NUMBERS WERE OFTEN WRITTEN IN THE REVERSE SEQUENCE, NAMELY SMALL NUMBER (SUBTRAHEND) MINUS THE LARGE NUMBER (MINUEND) - AN EQUATION IMPOSSIBLE TO COMPUTE.

ANOTHER CONCERN OF THE CLASSROOM TEACHERS WAS THE INABILITY OF MANY CHILDREN TO LABEL THEIR ANSWERS CORRECTLY, OR EVEN LABEL THEM AT ALL. WHEN SOLVING WRITTEN VERBAL WORD PROBLEMS, MANY CHILDREN DID NOT SEEM TO KNOW WHAT THE NUMBER RESULT OF A COMPUTATION REFERRED TO. (EX. CHILDREN MIGHT LABEL THE NUMBER RESULT OF THE AFOREMENTIONED WORD PROBLEM - JACK ATE 2 GUMBALLS, ETC. - AS 7 BOXES.)

THIS PRACTICUM ADDRESSES THE PROBLEM OF THIRD GRADERS' POOR PROBLEM-SOLVING ABILITIES IN ADDITION AND SUBTRACTION WRITTEN VERBAL WORD PROBLEMS. IT ALSO DISCUSSES THE EFFECT OF A FORCED-CHOICE WORD PROBLEM WORKBOOK, THAT WAS DESIGNED PRIMARILY TO REENFORCE THE FOLLOWING SKILL AREAS:

1. SUBTRAHEND-MINUEND ORDER OF MENTION IN SUBTRACTION WORD PROBLEMS. (ALSO REFERRED TO AS "NUMBER ORDER" IN THIS PRACTICUM).
2. LABELING IN WORD PROBLEMS.

BY DEFINITION:

1. A SUBTRAHEND IS A NUMBER WHICH IS SUBTRACTED FROM ANOTHER NUMBER (MINUEND).
2. A MINUEND IS A NUMBER FROM WHICH ANOTHER NUMBER (SUBTRAHEND) IS SUBTRACTED.
3. ORDER OF MENTION REFERS TO THE SEQUENCE IN WHICH NUMBERS ARE MENTIONED IN A WORD PROBLEM.
4. SUBTRAHEND-MINUEND ORDER OF MENTION REFERS TO A WORD PROBLEM WHERE THE SMALLER NUMBER IS MENTIONED FIRST, AND THE LARGER NUMBER - LAST.

EXCEPT IN WORD PROBLEMS WHERE THE MINUEND AND SUBTRAHEND ARE IDENTICAL (EX. 300-300=?), USING MINUEND-SUBTRAHEND ORDER IN SUBTRACTION WORD PROBLEMS REQUIRES THAT THE CHILD MAKE THE FOLLOWING DECISIONS WHEN CONFRONTED WITH TWO DIFFERENT NUMBERS IN A WORD PROBLEM:

1. WHICH OF THE TWO NUMBERS IS LARGER?
2. WHERE IS THE LARGER NUMBER PLACED? ON TOP? ON BOTTOM?
3. IF THE LARGER NUMBER (MINUEND) IS PLACED ON TOP, IS IT POSSIBLE TO SUBTRACT THE SMALLER NUMBER (SUBTRAHEND) FROM THE LARGER NUMBER? (YES)

4. If the smaller number (subtrahend) is placed on top, is it possible to subtract the larger number (minuend) from the smaller number? (No)

The skill of Subtrahend-Minuend Order of Mention in Subtraction Word Problems is necessary to solve the following types of question components of a verbal word problem:

(1) How many more...?
(2) How much older...?
(3) How much younger...?
(4) How much change...?
(5) How many...were left?
(6) How much longer...?
(7) What was the difference...?

The skill of Labeling is defined as the correct use of a noun or symbol in conjunction with a number which answers the question component of a verbal word problem. (Ex. 7 balls, 35¢, 26% etc.)

To document this problem, the Writer designed a 20 Written Verbal Word Problem Pre/Post Test (see Appendix 3) that correlated with each of the 20 Addition and Subtraction skill areas in the Third Grade Balanced Curriculum. This Pre-test, given to approximately 120 Third Grade students in South Miami Heights Elementary School, revealed 1,726 Labeling errors (71%) and 125 Subtrahend-Minuend errors(47%) in subtraction word problems, indicating the need for improved teaching strategies and instructional materials in these two skill areas.

A total of 843 students in nine Elementary Schools and one Private School in Dade, Broward, Palm Beach and St. John's counties were Pre-Tested. The accessible population of 120 Third Grade students in South Miami Heights Elementary School was the Experimental Group (70 students in three classes) and the Control Group (50 students in two classes).

The purpose of testing in Broward, Palm Beach and further north in St. John's County, was to ascertain whether these two problem skills (Labeling and Subtrahend-Minuend Number Order in Subtraction Word Problems) were local problems, peculiar to Dade County, or wider in scope, extending into other counties, which have a different ratio of ethnic composition.

B. Documentation of the Problem.

Problem-solving abilities of American students have been declining steadily for the past twenty years.[1] During the 1970's, there was a steady decline in the problem-solving abilities of American college-bound students, as measured by Scholastic Aptitude Test (SAT) scores.[2]

The United States is in the midst of a math crisis which did not happen overnight. Left unchecked, this scientific and technological "illiteracy" could eventually threaten this country's economy and defense. Advanced math courses are top priority in Japan, Russia and Germany. In the United States, fewer and fewer students are enrolled in these courses.

At their 1980 Conference, members of the National Council of Teachers of Mathematics (NCTM) recognized the improvement of problem-solving skills as the single most pressing curriculum issue facing them in the 1980's.[3]

THEIR RECOMMENDED ACTIONS STATE:

1. THE MATHEMATICS CURRICULUM SHOULD BE ORGANIZED AROUND PROBLEM-SOLVING.
2. APPROPRIATE CURRICULAR MATERIALS TO TEACH PROBLEM-SOLVING SHOULD BE DEVELOPED FOR ALL GRADE LEVELS.

CONCURRING WITH THE NCTM, THE NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS (NAEP) IN ITS LATEST SURVEY OF MATH SKILLS, FOUND THAT "STUDENTS APPEAR TO BE LEARNING MANY MATHEMATICAL SKILLS AT A ROTE MANIPULATION LEVEL AND DO NOT UNDERSTAND THE CONCEPTS UNDERLYING THE COMPUTATION. STATED ANOTHER WAY, PUPILS FIND IT DIFFICULT TO APPLY CLASSROOM THEORY TO NUMERICAL PROBLEMS OF EVERYDAY LIFE."[4]

IN AGREEMENT WITH NAEP AND NCTM, A TOP ADMINISTRATOR IN DADE COUNTY RECENTLY CONFIDED TO THIS WRITER: "THE RECENT PERFORMANCE OF 11TH GRADE STUDENTS ON THE PROBLEM SOLVING SECTION OF THE SAT WAS DEPLORABLE. MANY STUDENTS ZIP THROUGH 100 COMPUTATIONAL PROBLEMS IN MULTIPLICATION WITH EASE, BUT WHEN THEY ARE PRESENTED WITH A SIMPLE WORD PROBLEM INVOLVING PERCENTAGES, WHICH IS THE PROCESS OF MULTIPLICATION, THEY ARE HOPELESSLY LOST. SKILLS IN UNDERSTANDING AND COMPUTING WORD PROBLEMS SHOULD BE INTRODUCED AND REENFORCED IN THE EARLY GRADES."

MOST PEOPLE WOULD AGREE THAT THE ULTIMATE GOAL OF MATHEMATICS INSTRUCTION IS PROBLEM SOLVING. VERBAL WORD PROBLEMS HAVE ALWAYS CAUSED PROBLEMS FOR TEACHERS AND PUPILS ALIKE, AND MUCH RESEARCH HAS BEEN DONE, AS WILL BE DISCUSSED IN THIS PRACTICUM.

MANY PEOPLE DREAD MATH AND EXPERIENCE A FEELING OF INADEQUACY WHEN WORKING WITH NUMBERS. SINCE "MATH ANXIETY" IS A WELL-KNOWN SYNDROME IN MANY ADULTS, AS WELL AS CHILDREN, THE POSSIBLE PREVENTION OF THIS PROBLEM IN THE EARLY CHILDHOOD YEARS BY IMPROVED METHODS AND MATERIALS SEEMS ADVISABLE

C. ANALYSIS OF THE CAUSES.

AS STATED PREVIOUSLY, THE PROBLEM-SOLVING ABILITY OF AMERICAN STUDENTS HAS BEEN DECLINING STEADILY FOR TWENTY YEARS, SINCE 1962, WHICH WAS THE HIGH POINT OF THE POST-SPUTNICK PUSH FOR IMPROVED TRAINING IN MATH AND SCIENCE FOR AMERICAN STUDENTS.

SOME OF THE REASONS CITED FOR THIS DECLINE INCLUDE:

1. LOSS OF MATH TEACHERS TO PRIVATE INDUSTRY BECAUSE OF THE SALARY DIFFERENTIAL, CREATING A SHORTAGE IN ALL 50 STATES.
2. A DULL, OUT-OF-DATE MATH CURRICULUM BASED MAINLY ON ROTE DRILL, WHICH BORES BOTH THE BRIGHT AND SLOW STUDENTS ALIKE.
3. LACK OF EMPHASIS ON USING MATHEMATICS TO SOLVE PRACTICAL PROBLEMS.
4. FAILURE OF ARITHMETIC BOOKS AND CLASSES TO INSTILL A "FEEL FOR NUMBERS."[5]

RECENT RESEARCH HAS SHOWN THAT YOUNG CHILDREN'S CONCEPTUAL FRAMEWORK FOR MATHEMATICS IS BUILT BY MANY EXPERIENCES WITH CONCRETE MATERIALS IN THE EARLY GRADES.[6] IN THE TYPICAL ELEMENTARY SCHOOL, BEFORE THE CHILD EMERGES FROM WHAT PIAGET TERMS THE "CONCRETE STAGE OF DEVELOPMENT,"[7] HE IS THRUST INTO "PAPER AND PENCIL" MATH. IN LOCK-STEP FASHION, THE HIGHER LEVEL CONCEPTS OF MULTIPLICATION AND DIVISION ARE THRUST UPON HIM, BEFORE HE HAS "INTERNALIZED" THE LOWER LEVEL CONCEPTS OF ADDITION AND SUBTRACTION.

ROTE MEMORIZATION OF NUMBER FACTS, WITHOUT AN ADEQUATE CONCEPTUAL FRAMEWORK DERIVED FROM SUFFICIENT EXPERIENCES WITH CONCRETE MATERIALS, HAS RESULTED IN MANY CHILDREN BEING PROFICIENT IN COMPUTATION; BUT, AS THEY MATURE, THEY ARE UNABLE TO APPLY THESE COMPUTATIONAL SKILLS TO A REAL-LIFE SITUATION. DECLINING SAT SCORES IN MATH CONCEPTS ATTEST TO THIS.

One of the reasons for this unfortunate state of affairs in math instruction appears to be inadequate or inappropriate teacher inservice education for the teaching of math, especially in the early grades, where children's apprehension of "numbers" sets in and is followed by a more permanent case of "math anxiety" as they mature. What is needed is an emphasis on <u>how</u> to teach a math concept or process, and also <u>when</u> to teach it. This Inservice Teacher Education needs to be ongoing, stressing simple classroom diagnostic techniques.[8]

Compounding the conceptualization problem is the problem of poor mastery of computational skills. The virtual elimination of drill in many schools has resulted in many mathematically powerless students.[9] Hopefully, with the new "basic skills" approach, the schools will soon be turning out more students with at least the ability to compute.

Some parents feel that the reason for their children's poor performance with word problems is the virtual exclusion of parents as "teaching partners". In two separate editorials, "New Math" was criticized because one parent was unable to do it[10] and the other parent, a math major, couldn't understand it![11]

Another "virtual exclusion" in first grade textbooks are addition and subtraction problems that include comparisons and additive problem solving.[12]

<u>Comparison subtraction</u> (Jack has 5 fish and Jim has 3 fish. How many more fish has Jack than Jim?) is modeled by making a set of five, then a set of three. Then the sets are compared by using one-to-one correspondence.

ADDITIVE SUBTRACTION (ANN HAS $2. ALTOGETHER SHE NEEDS $6. HOW MANY MORE DOLLARS DOES ANN NEED?) RELATES TO THE MISSING ADDEND EQUATION. IT IS MODELED BY CREATING A SET OF TWO AND THEN ENLARGING IT TO A SET OF SIX. FINALLY, THE NUMBER OF DOLLARS ADDED TO THE SET OF TWO IS DETERMINED.

RECENT RESEARCH BY SHORES AND UNDERHILL,[13] MARSHALL[14] AND HARVEY[15] CONCLUDES THAT FIRST GRADERS CAN PROFIT FROM SUCH INSTRUCTION IN COMPARATIVE AND ADDITIVE SUBTRACTION. HARVEY ALSO NOTED THAT THE PRESENT CURRICULUM INCLUDED VERY LITTLE WORK WITH ADDITIVE SUBTRACTION WORD PROBLEMS.

EDUCATORS KNOW THAT SUBTRACTION EQUATIONS ARE MORE DIFFICULT THAN ADDITION EQUATIONS.[16] SUBTRACTION EQUATIONS INVOLVING MISSING MINUENDS ARE THE MOST DIFFICULT TO COMPUTE (EX. □ - $2 = $4) BECAUSE THE CHILD IS REQUIRED TO CONVERT HIS "MIND-SET" OF THE SUBTRACTION PROCESS (THERE IS A MINUS SIGN IN THE EQUATION) TO THE ADDITION PROCESS, IN ORDER TO ARRIVE AT THE CORRECT ANSWER. MISSING SUBTRAHEND EQUATIONS RANK SECOND IN DIFFICULTY (EX. $6 - □ = $4) BECAUSE THE SUBTRACTION "MIND-SET" REMAINS UNCHANGED DURING THE COMPUTATIONAL PROCESS.

MISSING ADDEND, MINUEND AND SUBTRAHEND PROBLEMS WILL CONTINUE TO BE TROUBLESOME AT ALL GRADE LEVELS UNLESS ACCURATE MODELING BEHAVIORS ARE STRESSED IN THE EARLY GRADES. THIS WILL REQUIRE MORE EXTENSIVE USE OF MANIPULATIVE AIDS (AND THE MONITORING OF THESE MANIPULATIVE ACTIVITIES FOR ACCURACY) THAN IS CURRENTLY BEING OBSERVED IN THE ELEMENTARY SCHOOLS.[17]

STATE-ADOPTED MATH WORKBOOKS ARE USED BY PUPILS ON ALL GRADE LEVELS. THESE WORKBOOKS SHOULD IMPROVE BOTH COMPUTATIONAL AND PROBLEM-SOLVING SKILLS. IT IS THE WRITER'S OPINION THAT CURRENT PROBLEM-SOLVING WORKBOOKS DO NOT MEET THE NEEDS OF YOUNG CHILDREN FOR THE FOLLOWING REASONS:

1. THE READING LEVEL IN THE MAJORITY OF WORKBOOKS IS NOT REALISTICALLY CONTROLLED FOR THE AVERAGE THIRD GRADE CLASS, WHICH HAS MORE THAN A FEW CHILDREN READING BELOW GRADE LEVEL.
2. THE SIZE AND STYLE OF THE PRINT ON THE WORKPAGES DO NOT MEET THE NEEDS OF MANY PERCEPTUALLY IMMATURE THIRD GRADE CHILDREN. IN DADE AND OTHER COUNTIES THROUGHOUT THE STATE OF FLORIDA, CHILDREN ARE TAUGHT TO WRITE, USING THE ZANER-BLOSER MANUSCRIPT METHOD. SOME WISE PUBLISHERS ARE PRODUCING BASAL READERS IN MANUSCRIPT PRINT. YET THE MAJORITY OF MATHEMATICAL WORKBOOKS USE THE TYPICAL WORKTEXT PRINT, WHICH IS OFTEN SMALLER IN SIZE THAN THE BASAL READER PRINT, AND USES "a" INSTEAD OF "ɑ", "g" FOR "ɡ", "t" INSTEAD OF "ŧ" AND OTHER LITTLE CURLICUES ON LETTERS. CHILDREN WHOSE PERCEPTUAL DEVELOPMENT IS DELAYED HAVE DIFFICULTIES MAKING THE TRANSITION FROM DECODING MANUSCRIPT WRITING AND READING, TO DECODING WORKTEXT PRINT.[18]
3. MOST NUMBERS IN WORD PROBLEMS ARE PRESENTED IN MINUEND-SUBTRAHEND ORDER (LARGE NUMBER FIRST - SMALLER NUMBER SECOND).
4. LABELING SKILLS ARE NOT ADEQUATELY EMPHASIZED OR REENFORCED.

A SURVEY OF POPULAR THIRD GRADE MATHEMATICAL WORKBOOKS USED IN THE DADE COUNTY PUBLIC SCHOOLS DISCLOSED THE FOLLOWING DATA:

1. MATHEMATICS WORKBOOK "A" (SEE APPENDIX 4)
   A. TYPE OF PRINT - WORKTEXT
   B. VOCABULARY LEVEL - TOO HIGH
      MANY THIRD GRADE STUDENTS WOULD HAVE DIFFICULTY DECODING THE UNDERLINED WORDS.
   C. LABELING SKILL - NOT BUILT INTO FORMAT

2. MATHEMATICS WORKBOOK "B" (SEE APPENDIX 5)
   A. TYPE OF PRINT - WORKTEXT, SMALL, INSUFFICIENT SPACES BETWEEN LINES
   B. VOCABULARY LEVEL - TOO HIGH (SEE UNDERLINED WORDS)
   C. LABELING SKILL - NOT BUILT INTO FORMAT

3. MATHEMATICS WORKBOOK "C" (SEE APPENDIX 6)
   A. TYPE OF PRINT - WORKTEXT, VERY SMALL
   B. VOCABULARY LEVEL - TOO HIGH (SEE UNDERLINED WORDS)
   C. MINUEND-SUBTRAHEND ORDER IS USED IN THE SOLE SUBTRACTION PROBLEM (PROBLEM D). THIS PROBLEM MENTIONS THE LARGE NUMBER FIRST (8) AND THE SMALLER NUMBER LAST (4). MOST CHILDREN WILL AUTOMATICALLY WRITE THE PROPER SEQUENCE, $8 - 4$ OR $\begin{array}{r} 8 \\ -4 \\ \hline \end{array}$ WITHOUT ATTENDING TO THE DIFFERENCE IN NUMERATION. ANOTHER VERSION OF THIS SAME PROBLEM, USING SUBTRAHEND-MINUEND NUMBER ORDER MIGHT BE:
      "BETH MENDED THE HOLES IN 4 SOCKS. SHE HAD 8 SOCKS WITH HOLES IN THEM. HOW MANY SOCKS DOES SHE HAVE LEFT TO MEND?"
   D. LABELING SKILL - NO PROVISION MADE FOR REENFORCEMENT.
      EX. $8 - 4 = 4$ HOLES OR 4 SOCKS?

4. MATHEMATICS WORKBOOK "D" (SEE APPENDIX 7)
   A. TYPE OF PRINT - WORD PROBLEMS #25 AND #26 IN WORKTEXT PRINT
   B. VOCABULARY LEVEL - CONTROLLED
   C. MINUEND-SUBTRAHEND ORDER IN BOTH PROBLEMS
   D. LABELING SKILL - NOT BUILT INTO THE FORMAT

5. MATHEMATICS WORKBOOK "E" (SEE APPENDIX 8)
   A. TYPE OF PRINT - WORD PROBLEMS IN WORKTEXT PRINT.
   B. VOCABULARY LEVEL - CONTROLLED
   C. MINUEND-SUBTRAHEND ORDER IS PRESENTED IN MOST SUBTRACTION PROBLEMS. (SUBTRAHEND-MINUEND ORDER SUBTRACTION PROBLEMS ARE CHECKED (✓)
   D. LABELING SKILL - NOT BUILT INTO FORMAT

6. MATHEMATICS WORKBOOK "F" (SEE APPENDIX 9)
   A. TYPE OF PRINT - WORKTEXT PRINT
   B. VOCABULARY LEVEL - CONTROLLED
   C. THERE ARE 100% MORE SUBTRACTION WORD PROBLEMS WITH NUMBERS PRESENTED IN MINUEND-SUBTRAHEND ORDER (LARGE NUMBER - SMALL NUMBER) THAN SUBTRAHEND-MINUEND ORDER (SMALL NUMBER - LARGE NUMBER). AN ANALYSIS OF THIS THIRD GRADE WORD PROBLEM WORKBOOK REVEALED THE FOLLOWING:

MINUEND-SUBTRAHEND ORDER	- 28 PROBLEMS	(67%)
SUBTRAHEND-MINUEND ORDER	- 14 PROBLEMS	(33%)
TOTAL # OF SUBTRACTION WORD PROBLEMS	- 42 PROBLEMS	(100%)

   D. LABELING SKILL - SOME REINFORCEMENT

7. Mathematics Workbook "G" (See Appendix 10)
   A. Type of print - manuscript
   B. Vocabulary level - not controlled for many first and second grade students
   C. There are no Subtrahend-Minuend subtraction word problems in this workbook. All 54 subtraction word problems were in Minuend-Subtrahend number order.
   D. Labeling Skill - inadequately reenforced.

8. Mathematics Workbook "H" (See Appendix 11)
   A. Type of print - manuscript
   B. Vocabulary level - not controlled for Grade 2. Language too involved.
   C. Minuend-Subtrahend order - An analysis of Second Grade Word Problem Workbook revealed the following:

Minuend-Subtrahend order	- 43 problems	(81%)
Subtrahend-Minuend order	- 10 problems	(19%)
Total # of subtraction word problems	- 53 problems	(100%)

   There are 300% more Minuend-Subtrahend (large number-small number) subtraction word problems presented to students in this Second Grade Book than Subtrahend-Minuend problems.
   D. Labeling Skill - inadequately reenforced. Label is provided by publisher.

As a result of this Workbook Research, it is the Writer's opinion that current math workbooks in popular use in the Dade County Public Schools are not meeting the needs of Third Grade children in two specific skill areas, namely:

1. Subtrahend-Minuend number order in written verbal word problems.
2. Labeling the number result of a written verbal word problem.

D. RELATIONSHIP OF THE PROBLEM TO THE LITERATURE.

PROBLEM SOLVING IS CONSIDERED TO BE THE ULTIMATE GOAL OF MATHEMATICS INSTRUCTION. A GREAT DEAL OF RESEARCH HAS BEEN DONE OVER THE YEARS TO PINPOINT MAJOR REASONS FOR THE ERRORS CHILDREN MAKE DURING THE PROBLEM-SOLVING PROCESS.

ACCORDING TO GROSSNICKLE,[19] ERRORS IN REASONING, AND POOR COMPREHENSION SKILLS WOULD ACCOUNT FOR CHILDREN'S DIFFICULTIES IN SOLVING VERBAL WORD PROBLEMS.

BLECHA[20] CONCURS WITH GROSSNICKLE, THAT A CHILD'S ABILITY TO HANDLE WORD PROBLEMS IS DETERMINED BY HIS MENTAL ABILITY. HOWEVER, BLECHA CONTENDS, A CHILD'S BACKGROUND IN MEANINGS, UNDERSTANDINGS, CONCEPTS AND SKILLS COULD AND SHOULD BE INFLUENCED BY THE TEACHER.

SMITH[21] EMPHASIZED THE IMPORTANCE OF THE CHILD'S READING ABILITY WHEN SOLVING A WRITTEN VERBAL WORD PROBLEM. IN SMITH'S OPINION, TO EVALUATE PROBLEM-SOLVING SKILLS OF A NON-READER, THE PROBLEMS HAVE TO BE READ TO THE CHILD.

BALOW,[22] AGREEING WITH SMITH'S EMPHASIS ON READING ABILITY WHEN SOLVING VERBAL WORD PROBLEMS, POINTED OUT THE IMPORTANCE OF CONSIDERING CHILDREN'S COMPUTATION ABILITY AS WELL AS READING ABILITY WHEN TEACHING PROBLEM-SOLVING SKILLS. BALOW CONSIDERS BOTH OF THESE FACTORS IMPORTANT TO THE CHILD IF HE IS TO DEAL ADEQUATELY WITH VERBAL WORD PROBLEMS IN HIS SCHOOL WORK.

RILEY AND PACHTMAN[23] DID NOT CONCUR WITH SMITH ON THE IMPORTANCE OF THE DIRECT APPLICATION OF BASIC READING SKILLS IN SOLVING WRITTEN VERBAL WORD PROBLEMS. THEY INDICATED THAT SOLVING THESE PROBLEMS WAS DEPENDENT UPON THE CHILD'S UNDERSTANDING OF CONCEPTS AND RELATIONSHIPS.

RILEY AND PACHTMAN, AGREEING WITH BLECHA, CONCLUDED THAT CHILDREN DEFINITELY NEEDED GUIDANCE IN READING AND UNDERSTANDING WRITTEN VERBAL WORD PROBLEMS.

COMMENTING ON THE SAME ISSUE NOT LONG AGO, DE CORTE AND VERSCHAFFEL[24] IN BELGIUM FOUND THAT SHORTCOMINGS OF CHILDREN'S KNOWLEDGE AND SOLUTION STRATEGIES COULD BE OVERCOME BY SYSTEMATIC INSTRUCTION OF A VARIETY OF PROBLEM-SOLVING PROCEDURES.

MATTHEWS[25] NOTED RECENTLY THAT MANY CHILDREN ARE EXPECTED TO DO MATHEMATICAL CALCULATIONS FOR WHICH THEY HAVE NOT YET DEVELOPED A CONCEPTUAL FRAMEWORK. IN SOLVING WORD PROBLEMS, THE OPERATION THAT APPEARS TO BE THE EASIEST IS ADDITION, FOLLOWED BY SUBTRACTION, MULTIPLICATION AND DIVISION. THE AUTHOR FOUND DURING HER RESEARCH INTO SUBTRACTION, THAT SOME YOUNG CHILDREN ARE ASKED TO DO SUMS WHICH ARE BEYOND THEIR COMPREHENSION, AND THE RESULTING CONFUSION IS DIFFICULT TO REMEDY LATER ON IN LIFE, OFTEN RESULTING IN "MATH ANXIETY".

NESHER AND KATRIEL,[26] COMMENTING ON THE DIFFERENT STRATEGIES TEACHERS HAVE DEVELOPED TO HELP CHILDREN SOLVE VERBAL WORD PROBLEMS, STRESSED THAT A CORRECT INTERPRETATION OF A WORD PROBLEM AS EITHER AN ADDITION OR SUBTRACTION TEXT MUST DISREGARD "VERBAL CUES", SUCH AS "MORE", "IN ALL", AND MUST REFER TO THE SET OF EVENTS DESCRIBED IN THE TEXT AS A WHOLE.

BURNS AND RICHARDSON[27] FOUND IT HELPFUL FOR CHILDREN TO CONCEPTUALIZE VERBAL WORD PROBLEMS BY ACTING OUT THE PROBLEMS BEFORE ATTEMPTING TO WRITE THEM DOWN. THE AUTHORS ALSO NOTE THAT PROBLEMS WHICH INCLUDE SOME TYPE OF VISUAL AID ARE EASIER FOR CHILDREN TO SOLVE THAN THOSE WITHOUT SUCH AIDS.

RESEARCH HAS BEEN DONE OVER THE YEARS THAT SEEMS TO POINT TO COMPUTATIONAL DIFFICULTIES AS A MAJOR DETERRANT TO FINDING CORRECT ANSWERS WHEN SOLVING PROBLEMS. IRELAND[28] CONCLUDED THAT HIGH ACHIEVERS IN ARITHMETIC WERE ABLE TO SOLVE WRITTEN ARITHMETIC PROBLEMS BETTER THAN LOW ACHIEVERS IN ARITHMETIC.

FROM ALL THIS RESEARCH, SOME GENERAL CONCLUSIONS HAVE EMERGED:

1. SOME PUPILS ARE VERY GOOD PROBLEM SOLVERS, WHILE OTHERS ARE NOT.
2. THERE IS A SIGNIFICANT CORRELATION BETWEEN IQ AND PROBLEM-SOLVING ABILITY.[29]

NEVERTHELESS, MANY STUDIES REENFORCE THE OPINION THAT CHILDREN CAN BE HELPED TO DEVELOP PROBLEM-SOLVING STRATEGIES BY <u>SYSTEMATIC TEACHING</u> OF A VARIETY OF PROBLEM-SOLVING PROCEDURES.

THE WRITER HAS DEVELOPED A THIRD GRADE WORD PROBLEM WORKBOOK IN ADDITION AND SUBTRACTION THAT HAS INCORPORATED MANY OF THESE RESEARCH FINDINGS INTO ITS FORMAT, TO HELP CHILDREN IMPROVE THEIR PROBLEM-SOLVING SKILLS.

CHAPTER III

Anticipated Outcomes and Evaluation Instruments

A. Statement of General Goals.

The primary goal of this practicum was to improve and increase the problem-solving skills of Third Grade children in South Miami Heights Elementary School by designing and implementing an addition and subtraction word problem workbook, using systematic problem-solving procedures.

After the implementation of this Workbook Program, it was expected that Third Grade teachers in both the Testing and Workbook Programs would show a positive attitude towards some systematic procedures for improving both the problem-solving competencies and computational skills of their students.

The final expectation was that the Third Grade children, after concluding the Workbook Program, would give it a positive evaluation.

B. Behavior Expected, Assessment Instruments, and Standard of Performance.

EXPECTED BEHAVIORS	ASSESSMENT INSTRUMENTS	STANDARD OF PERFORMANCE
After a 4 month implementation of a Forced-Choice Verbal Word Problem Workbook, there will be:		
Improved performance of 3rd Grade Experimental Group in the following skill areas:	Post-test of Third Grade Word Problem Test*(Pre-test was administered before implementation of the Workbook Program)	
A. Subtrahend-Minuend Number Order in word problems.		Criterion for success will be a 15% average increase in the number of correct equations for Problem #9 and #20, as compared to the Pre-Test (These 2 problems are worded in Subtrahend-Minuend order).
B. Labeling of numerical answers to word problems. Ex. 7 + 2 = 9 DOGS		Criterion for success will be a 25% average increase in the number of correct labels as compared to the Pretest
Third Grade Teachers (41) involved in the Testing Program will demonstrate awareness of need for emphasizing problem-solving skills as well as computational proficiency in mathematics curriculum.	Third Grade Word Problem Test and Classroom Profile - Classroom Teacher Evaluation*	A positive evaluation will be one in which 80% of the respondents (Third Grade teachers who were involved in the Testing Program) reported having greater awareness of the importance of improving problem-solving skills as well as computational competencies.
Teachers (3) involved in the Workbook Program will demonstrate a positive attitude toward a systematic approach to teaching problem-solving skills.	Third Grade Word Problem Workbook Program - Classroom Teacher Evaluation*	Criterion for success will be ✓'s in the Moderately, Quite a Bit, and Extremely columns of 50% of the items.
Children involved in the Workbook Program (78) will demonstrate enthusiasm for a systematic approach to teaching problem-solving skills.	Third Grade Word Problem Workbook Program - Pupil Evaluation Form*	A positive evaluation will be one in which 70% of the 3rd Grade students in the Experimental Group colored in the circles preceding the following: 1. I liked the stories. 2. The words in the stories were easy to read. 3. I would like to do more of these problem-solving workpages in fourth grade.

*Copy in Appendix of Proposal

C. Description of Evaluation Instruments.

To ascertain the extent of the difficulties children are experiencing when attempting to solve written verbal word problems, the Writer devised a 20 Verbal Word Problem Pre/Post Test in Addition and Subtraction. Each of the 20 word problems tests a separate skill required of Third Grade students for compliance with the 1980-81 Balanced Curriculum in Dade County, Florida.

1. The 20 Written Verbal Word Problem Pre/Post Test

A Primary typewriter was used in the construction of the test for perceptual adequacy. This four page test was printed on one side only, with 5 problems on each page.

The letter "a" on the Primary typewriter was not used. Instead the letter "ɑ" was substituted. To convert it to an "a", the "stick" below the line was whited out with Liquid Paper. There were approximately 149 "ɑ's" converted to "a's" in this manner.

Research has shown that many Third Grade children are reading below grade level. Therefore, the Reading Level of the test was controlled at the 1.5 - 2.0 level, based on the Spache Readability Formula.[30]

Word problems #9 and #20 were worded in Subtrahend-Minuend Number Order (smaller number mentioned first - larger mentioned last) to ascertain to what extent Third Grade children were routinely writing down the first number mentioned in a word problem and then attempting to subtract the second number from the first number. If children were using this "Order of Mention" system as their teachers claimed, then Problem #9 would be recorded as $\begin{array}{r} 135 \\ -214 \\ \hline \end{array}$. Similarly, #20 would be $\begin{array}{r} 25¢ \\ -50¢ \\ \hline \end{array}$.

DIRECTIONS FOR ADMINISTERING THE TEST WERE GIVEN TO EACH CLASSROOM TEACHER (SEE APPENDIX 12). ALTHOUGH NO TIME LIMIT WAS SET, TEST DURATION FOR MOST OF THE THIRD GRADE STUDENTS WAS 15 - 30 MINUTES.

THIS 20 WRITTEN VERBAL WORD PROBLEM PRE/POST TEST WAS FIELD-TESTED WITH L.D. STUDENTS IN GRADES 3-6. THIRD GRADE L.D. STUDENTS INVOLVED IN THIS FIELD-TEST WERE NOT INCLUDED IN THE TESTING PROGRAM.

2. THIRD GRADE WORD PROBLEM TEST AND CLASSROOM PROFILE (SEE APPENDIX 13); CLASSROOM TEACHER EVALUATION (SEE APPENDIX 14)

FORTY-ONE THIRD GRADE CLASSROOM TEACHERS IN 10 ELEMENTARY SCHOOLS IN 4 COUNTIES IN FLORIDA WERE ASKED TO EVALUATE THE THIRD GRADE WORD PROBLEM TEST AND CLASSROOM PROFILE. THIS CLASSROOM PROFILE ANALYZED THE TYPES OF ERRORS CHILDREN MADE IN EACH SKILL AREA, SUCH AS C (COMPUTATIONAL), P (PROCESS), AND L (LABELING). AN EXAMPLE OF ALL 3 TYPES OF ERRORS POSSIBLE IN WORD PROBLEM #4 WOULD BE:

$$\begin{array}{r} 17 \\ +\ 9 \\ \hline -12 \end{array}$$ HATS.

3. THIRD GRADE WORD PROBLEM WORKBOOK PROGRAM CLASSROOM TEACHER EVALUATION (SEE APPENDIX 15)

THE GOAL OF THE WORD PROBLEM WORKBOOK PROGRAM WAS TO HELP THIRD GRADE TEACHERS IMPROVE THEIR STUDENTS' SKILLS IN BOTH PROBLEM-SOLVING AND COMPUTATION. THREE THIRD GRADE CLASSROOM TEACHERS OF THE EXPERIMENTAL GROUP IN SOUTH MIAMI HEIGHTS ELEMENTARY SCHOOL EVALUATED THIS FOUR-MONTH-LONG PROGRAM.

4. Third Grade Word Problem Workbook Program

Pupil Evaluation (See Appendix 16)

Approximately 78 Third Grade students in the Experimental Group (3 classes) evaluated the workbook. The Pupil Evaluation Form was designed in the same Forced-Choice format as the Word Problem Workbook, using colored circles to indicate the students' responses. There was a section reserved for individual comments.

CHAPTER IV
SOLUTION STRATEGY

A. DISCUSSION AND EVALUATION OF POSSIBLE SOLUTIONS.

THE PROBLEM THAT TODAY'S MATH CURRICULUM IS OUT OF DATE, DULL AND GEARED TO SLOWER STUDENTS WAS EMPHASIZED AT THE 1980 MEETING OF THE 80,000 MEMBER NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS. TO BREATHE NEW LIFE INTO THE ENTIRE MATH CURRICULUM WOULD INVOLVE HIRING ADDITIONAL MATH EXPERTS TO SET UP INSERVICE TEACHER TRAINING PROGRAMS. NOT ONLY IS THERE AN EXISTING SHORT SUPPLY OF MATH TEACHERS, BUT THE FEW WHO ARE COMING OUT OF COLLEGES TODAY ARE TAKING TECHNICAL JOBS IN PRIVATE INDUSTRY AT MUCH HIGHER SALARIES THAN THE SCHOOLS ARE WILLING TO PAY. SETTING UP THESE INSERVICE TRAINING PROGRAMS DID NOT SEEM TO BE A PRACTICAL APPROACH.

ANOTHER POSSIBLE SOLUTION ON THE SCHOOL LEVEL WOULD BE THE HIRING AND TRAINING OF TEACHER AIDES IN THE K-3 GRADES, TO MONITOR THE USE OF MANIPULATIVES IN ALL INTRODUCTORY MATH WORK WITH YOUNG CHILDREN. STEFFE[31] AND LE BLANC[32] STRESS ACCURATE MODELING BEHAVIORS FOR FIRST GRADE MATH INSTRUCTION. THIS SOLUTION WAS REJECTED FOR BUDGETARY REASONS.

ANOTHER APPROACH CONSIDERED WAS PARENT VOLUNTEERS. SINCE THE COMMUNITY IS MAINLY A "BLUE-COLLAR" AREA, BOTH PARENTS OF MOST CHILDREN ARE EMPLOYED, AND THEREFORE, NOT AVAILABLE ON A REGULAR BASIS FOR VOLUNTEER WORK.

B. DESCRIPTION AND JUSTIFICATION FOR SOLUTION SELECTED.

AFTER REJECTING THE AFOREMENTIONED APPROACHES, THE WRITER DECIDED THE MOST PRACTICAL SOLUTION TO THE PROBLEM APPEARED TO BE TO DESIGN AN ADDITION AND SUBTRACTION WORD PROBLEM WORKBOOK FOR IMPROVING THE PROBLEM-SOLVING SKILLS OF THIRD GRADE CHILDREN, USING A SYSTEMATIC, PROGRAMMED APPROACH.

AS PREVIOUSLY MENTIONED IN CHAPTER II SECTION C, THERE ARE MANY STATE-ADOPTED MATH WORKBOOKS USED BY STUDENTS ON EVERY GRADE LEVEL. HOWEVER, THERE ARE NO THIRD GRADE PROBLEM-SOLVING WORKBOOKS THAT MEET THE WRITER'S CRITERIA FOR:

1. READABILITY LEVEL
2. SIZE AND STYLE OF PRINT
3. MINIMUM PERCENTAGE (50%) OF WORD PROBLEMS WITH SUBTRAHEND-MINUEND NUMBER ORDER
4. PROGRAMMED INSTRUCTION WITH $\begin{array}{l}\text{BIGGER NUMBER}\\ -\ \underline{\text{SMALLER NUMBER}}\end{array}$ FORMAT IN SUBTRACTION WORD PROBLEMS
5. SYSTEMATIC REENFORCEMENT OF LABELING SKILLS
6. STIMULATION OF THINKING SKILLS (FORCED-CHOICE FORMAT).

ACCORDING TO BELL[33] AND COFFLAND[34], TOO MANY WORD PROBLEMS ON THE MARKET ARE MERELY EXERCISE-SOLVING, WHICH REQUIRE ONLY ROUTINE APPLICATION OF PREVIOUSLY LEARNED FACTS AND PROCEDURES. PROBLEM-SOLVING, ON THE OTHER HAND, USUALLY REQUIRES SOME CREATIVITY IN ANALYZING, SYNTHESIZING AND EVALUATING SITUATIONS.

THE WRITER'S WORKBOOK WAS DESIGNED TO BE A PROBLEM-SOLVING WORKBOOK, DEVOID OF STILTED AND STEREOTYPED SETTINGS.[35] IN ADDITION, THROUGHOUT THE WORKBOOK, CHILDREN HAVE THE OPPORTUNITY TO RESPOND TO REAL-LIFE PROBLEMS WITH WRITTEN LANGUAGE.

C. ROADMAP FOR ACTION

Dec. 1981	Permission granted by Principal to proceed with Plan
Dec. 1981 - Jan. '82	Literature Review
Jan. - Feb. 1982	Design the Forced-Choice Word Problem Workbook with 20 Third Grade math skills in addition and subtraction.
	Pre-Test Experimental and Control Groups.
	Pre-Test High, Middle and Low Income Third Grade Students.
	Duplicate Workbook Pages.
	Assemble 100 Workbooks.
Feb. 1982 March April May	Implement 2 workbook pages weekly with Experimental Group.
June 1982	Workbook Program evaluated by Third Grade Students, Third Grade Classroom Teachers in Testing Program and Third Grade Classroom Teachers of Experimental Group.
	Post-Testing of Experimental and Control Groups at South Miami Heights Elementary School.
July, Aug. '82	Compilation of data.
Sept.-Oct. '82	Write and submit Practicum Report to Nova University.

D. REPORT OF ACTION TAKEN

THE "ROADMAP FOR ACTION", AS PRESENTED IN THIS CHAPTER, SECTION C WAS FOLLOWED BY THE WRITER DURING THE IMPLEMENTATION STAGE OF THIS PRACTICUM.

TO DOCUMENT THE TWO PROBLEM SKILL AREAS OF:

1. SUBTRAHEND-MINUEND ORDER OF MENTION IN SUBTRACTION WORD PROBLEMS, AND
2. LABELING,

THE WRITER DESIGNED A 20 WRITTEN VERBAL WORD PROBLEM PRE-POST TEST THAT CORRELATED WITH EACH OF THE 20 SKILL AREAS IN THE THIRD GRADE BALANCED CURRICULUM IN DADE COUNTY, FLORIDA.

TO ASCERTAIN THE EXTENT OF THE TWO PROBLEMS, THIS TEST WAS ADMINISTERED TO 843 THIRD GRADE CHILDREN IN 41 CLASSROOMS IN 10 ELEMENTARY SCHOOLS (9 PUBLIC SCHOOLS - 1 PRIVATE SCHOOL) IN 4 COUNTIES IN THE STATE OF FLORIDA. THESE 10 SCHOOLS WERE SELECTED ON THE BASIS OF PERSONAL ACCESS.

THE VOCABULARY USED IN THE WORD PROBLEMS WAS CONTROLLED AT THE 1.5-2.0 READING LEVEL. PUPILS READING BELOW 1.5 READING LEVEL WERE NOT INCLUDED IN THE STUDY. STUDENTS' READING LEVELS WERE DERIVED FROM THE GINN PLACEMENT TEST, THE INFORMAL READING INVENTORY, AND TEACHER JUDGMENT.

FOR THE PURPOSE OF THIS PRACTICUM, THE 10 SCHOOLS IN THE STUDY WERE CLASSIFIED AS HIGH, MIDDLE AND LOW INCOME ACCORDING TO THE SOCIO-ECONOMIC PREDICTOR VARIABLES LISTED IN TABLE 1(SEE FOLLOWING PAGE).

TABLE 1

SOCIO-ECONOMIC PREDICTOR VARIABLES OF
10 SCHOOLS IN PRE-TESTING PROGRAM
(DISTRICT AND SCHOOL PROFILES 1980-81)

SOCIO-ECONOMIC LEVEL	NUMBER OF CHILDREN TESTED	NUMBER OF SCHOOLS	ESTIMATED % "WHITE COLLAR"* OCCUPATION	% STUDENTS RECEIVING FREE/REDUCED LUNCH	ESTIMATED % PARENTS WITH SOME COLLEGE EDUCATION**
HIGH INCOME	320	4	60 - 100	0 - 10	60 - 100
MIDDLE INCOME	254	3	20 - 60	10 - 40	10 - 60
LOW INCOME	269	3	0 - 20	40 - 100	0 - 10
TOTAL	843	10			

* CHIEF "BREADWINNER" IS EMPLOYED IN A "WHITE COLLAR" OCCUPATION.

** EITHER PARENT HAVING SOME COLLEGE EDUCATION, NOT INCLUDING VOCATIONAL AND TECHNICAL EDUCATION.

(SEE APPENDIX 17)

AFTER DOCUMENTING THE TWO PROBLEMS OF POOR SKILLS IN:

1. SUBTRAHEND-MINUEND ORDER OF MENTION IN SUBTRACTION WORD PROBLEMS, AND
2. LABELING,

THE WRITER DESIGNED THE FORCED-CHOICE THIRD GRADE ADDITION AND SUBTRACTION WORD PROBLEM WORKBOOK (SEE APPENDIX 27) THAT CORRELATED WITH EACH OF THE 20 ADDITION AND SUBTRACTION SKILL AREAS IN THE THIRD GRADE BALANCED CURRICULUM IN DADE COUNTY, FLORIDA. THIS WORKBOOK MET THE WRITER'S CRITERIA FOR:

1. READABILITY LEVEL - 1.5-2.0
2. SIZE AND STYLE OF PRINT - LARGE, HAND-WRITTEN MANUSCRIPT LETTERS
3. 50% OF WORD PROBLEMS WITH SUBTRAHEND-MINUEND NUMBER ORDER OF MENTION
4. PROGRAMMED INSTRUCTION WITH BIGGER NUMBER FORMAT IN SUBTRACTION WORD PROBLEMS. - SMALLER NUMBER
5. SYSTEMATIC REENFORCEMENT OF LABELING SKILLS BY THE USE OF DOUBLE ASTERISKS (**) AT THE BEGINNING OF THE QUESTION COMPONENT OF THE WORD PROBLEM. (EX.: **HOW MUCH MONEY ....?)
6. STIMULATION OF THINKING SKILLS (FORCED-CHOICE FORMAT).
7. OPPORTUNITIES FOR STUDENTS TO IMPROVE THINKING SKILLS BY SOLVING REAL-LIFE PROBLEMS THAT DID NOT INVOLVE NUMBERS.

THIS WORKBOOK WAS IMPLEMENTED, 2 PAGES WEEKLY, OVER A FOUR-MONTH PERIOD. THIRD GRADE CLASSROOM TEACHER AND PUPIL EVALUATIONS TOOK PLACE AT THE CONCLUSION OF THE WORKBOOK PROGRAM, FOLLOWED BY POST-TESTING OF THE EXPERIMENTAL AND CONTROL GROUPS AT THE END OF THE SCHOOL YEAR IN JUNE 1982.

CHAPTER V

RESULTS
CONCLUSIONS
RECOMMENDATIONS

AS PREVIOUSLY STATED IN CHAPTER III SECTION A, THE PRIMARY GOAL OF THIS PRACTICUM WAS TO IMPROVE AND INCREASE THE PROBLEM-SOLVING SKILLS OF THIRD GRADE CHILDREN IN SOUTH MIAMI HEIGHTS ELEMENTARY SCHOOL BY DESIGNING AND IMPLEMENTING AN ADDITION AND SUBTRACTION WORD PROBLEM WORKBOOK, USING SYSTEMATIC, PROBLEM-SOLVING PROCEDURES.

IMPROVEMENT IN TWO PROBLEM-SOLVING SKILLS, NUMBER ORDER AND LABELING, WAS MEASURED BY COMPARING PRE- AND POST-TEST SCORES OF BOTH THE EXPERIMENTAL AND CONTROL GROUPS ON THE 20 VERBAL WORD PROBLEM TEST DESIGNED BY THE WRITER.

IT WAS ALSO EXPECTED THAT THIRD GRADE TEACHERS WOULD DEMONSTRATE:

1. AN AWARENESS OF THE NEED FOR IMPROVED PROBLEM-SOLVING AND COMPUTATIONAL SKILLS OF THEIR STUDENTS,
2. A POSITIVE ATTITUDE TOWARDS THESE SYSTEMATIC PROCEDURES DESIGNED FOR THE IMPROVEMENT OF THESE SKILLS.

THESE ITEMS WERE MEASURED BY THE RESPONSES ON THE TEACHER EVALUATION FORMS.

THE FINAL EXPECTATION WAS THAT THIRD GRADE STUDENTS, AFTER COMPLETING THE WORKBOOK PROGRAM, WOULD DEMONSTRATE ENTHUSIASM FOR THIS SYSTEMATIC APPROACH TO TEACHING PROBLEM-SOLVING SKILLS, BY MAKING POSITIVE RESPONSES ON THE PUPIL EVALUATION FORM.

A. PRESENTATION AND ANALYSIS OF RESULTS

TYPES OF ERRORS ON THE 20 WORD PROBLEM PRE-TEST WERE RECORDED IN THE FOLLOWING MANNER:

1. N.O. = NUMBER ORDER - PUPIL WROTE $\begin{array}{r} 135 \\ -\ 214 \\ \hline \end{array}$ (PROBLEM #9)

   - PUPIL WROTE $\begin{array}{r} 25¢ \\ -\ 50¢ \\ \hline \end{array}$ (PROBLEM #20)

2. L = LABELING - ANSWER LABELED INCORRECTLY OR OMITTED.

3. C = COMPUTATION - EX.: 6 + 3 = 10.

4. P = PROCESS - WRONG PROCESS CHOSEN TO SOLVE THE WORD PROBLEM

5. P.E. = PERCEPTUAL ERROR (INVOLVING NUMBERS ONLY)
   - ERRORS OF OMISSION, TRANSPOSITION AND SUBSTITUTION.

LISTED BELOW ARE THE 5 ERROR CATEGORIES, AND THE AVERAGE PERCENT OF ERRORS FOR EACH OF THE THREE SOCIO-ECONOMIC GROUPS.

— HIGH INCOME - N = 320 STUDENTS
MIDDLE INCOME - N = 254 STUDENTS
LOW INCOME - N = 269 STUDENTS

1. NUMBER ORDER (SEE TABLE 2)
   HIGH INCOME - 28%
   MIDDLE INCOME - 48%
   LOW INCOME - 56%

2. LABELING (SEE TABLE 3)
   HIGH INCOME - 20%
   MIDDLE INCOME - 27%
   LOW INCOME - 42%

3. Computation (see Table 4)
   High Income - 8%
   Middle Income - 14%
   Low Income - 14%

4. Process (see Table 5)
   High Income - 4%
   Middle Income - 10%
   Low Income - 11%

5. Perceptual Errors (see Table 6)
   These included number errors only, such as omissions, transpositions and substitutions.
   High Income - 23%
   Middle Income - 28%
   Low Income - 34%

Discussion of Results

Word Problems #12 (Subtraction with 0; 2 digits and 2 digits - regrouping) and #14 (Subtraction with 0; 3 digits and 3 digits - regrouping) tested the skill of Subtraction with 0. An average of 23% of all the Third Grade pupils tested scored computational errors on Word Problem #12; similarly, 40% scored computational errors on Word Problem #14 (Tables 8, 9, and 10).

The Middle and Low socio-economic groups scored approximately twice as many errors on these two skills as the High socio-economic group.

TABLE 2

20 VERBAL WORD PROBLEM TEST RESULTS

AVG. PERCENTAGE OF NUMBER ORDER ERRORS

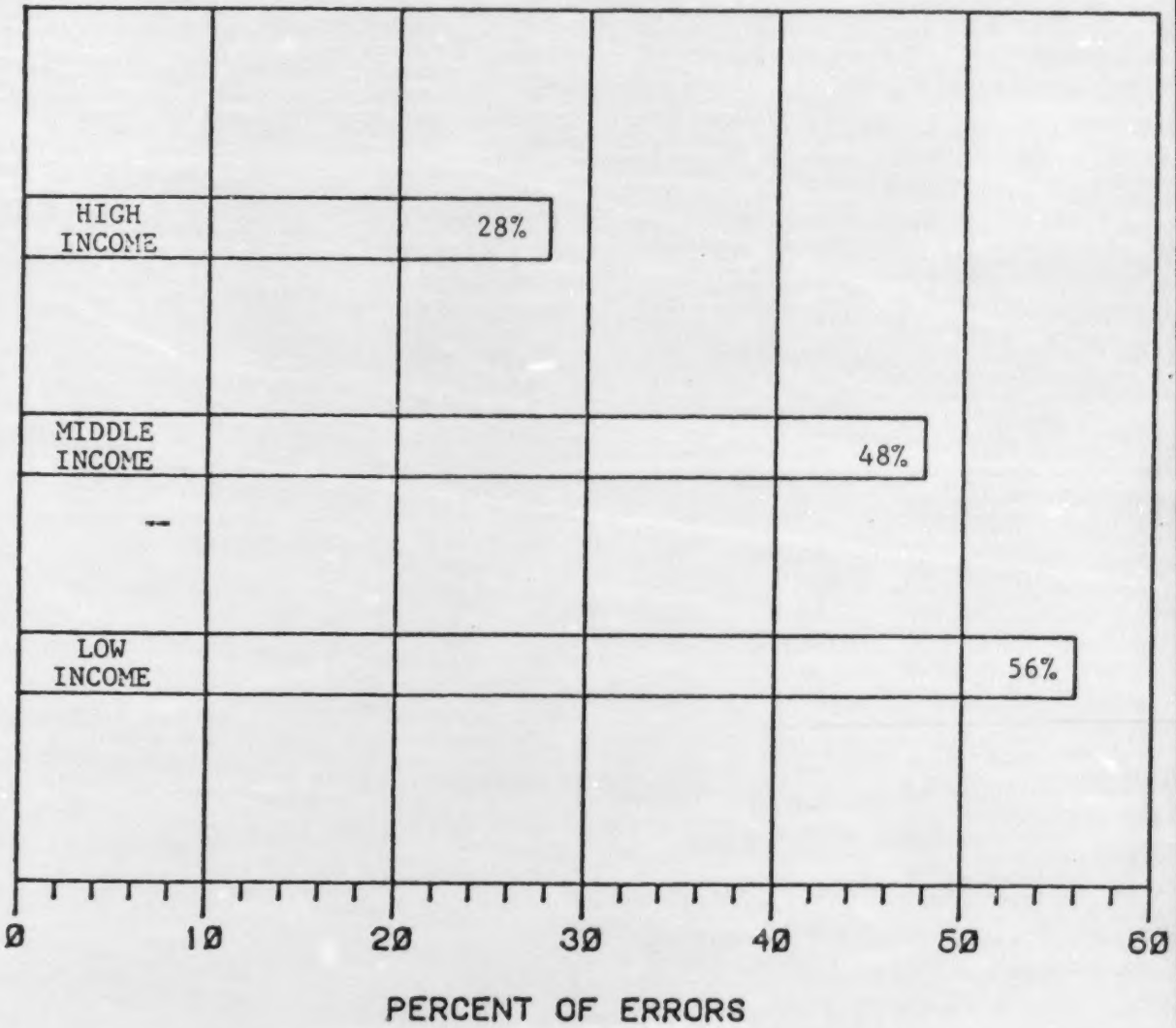


TABLE 3

20 VERBAL WORD PROBLEM TEST RESULTS

AVERAGE PERCENTAGE OF LABELING ERRORS

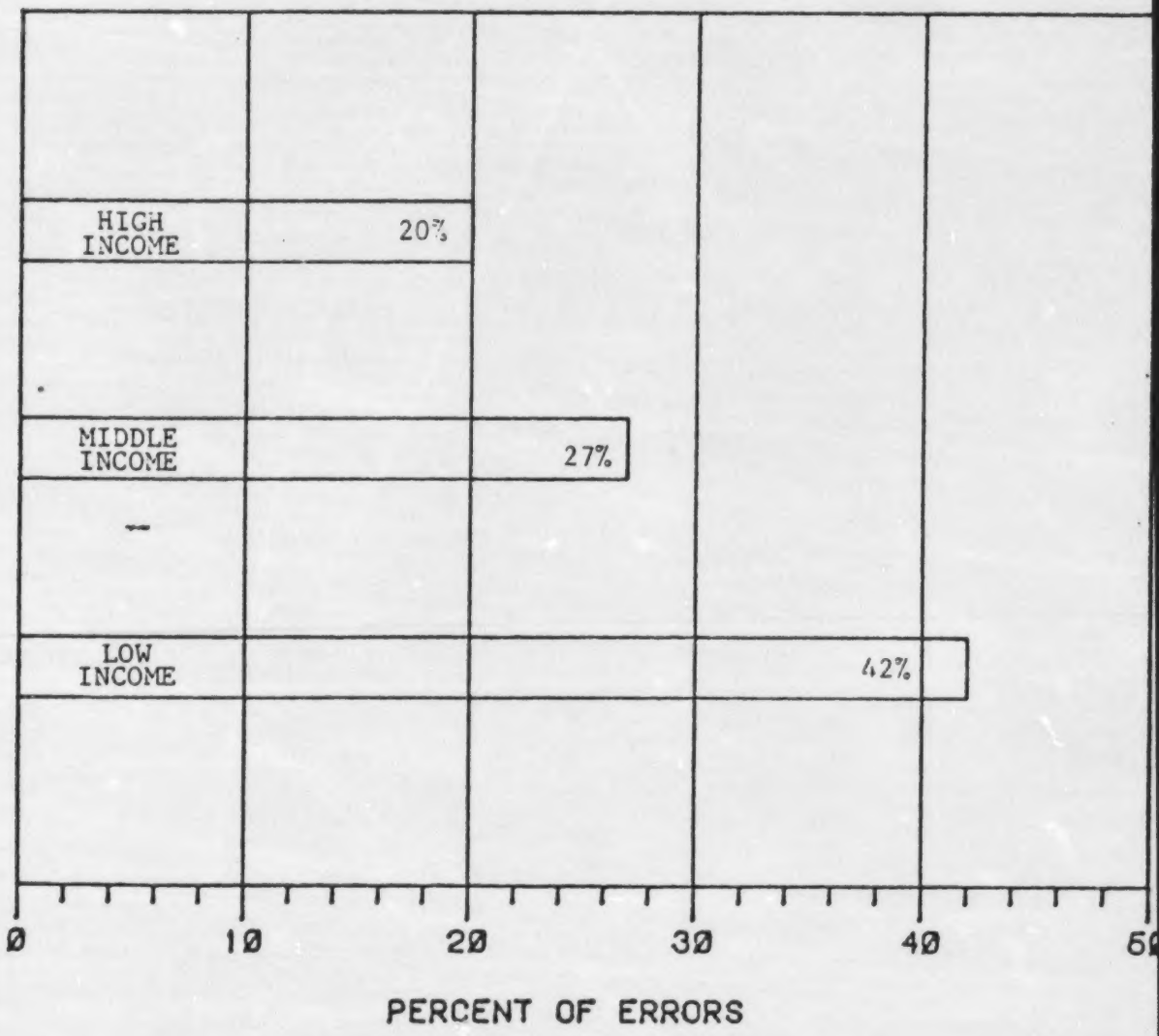


TABLE 4

20 VERBAL WORD PROBLEM TEST RESULTS

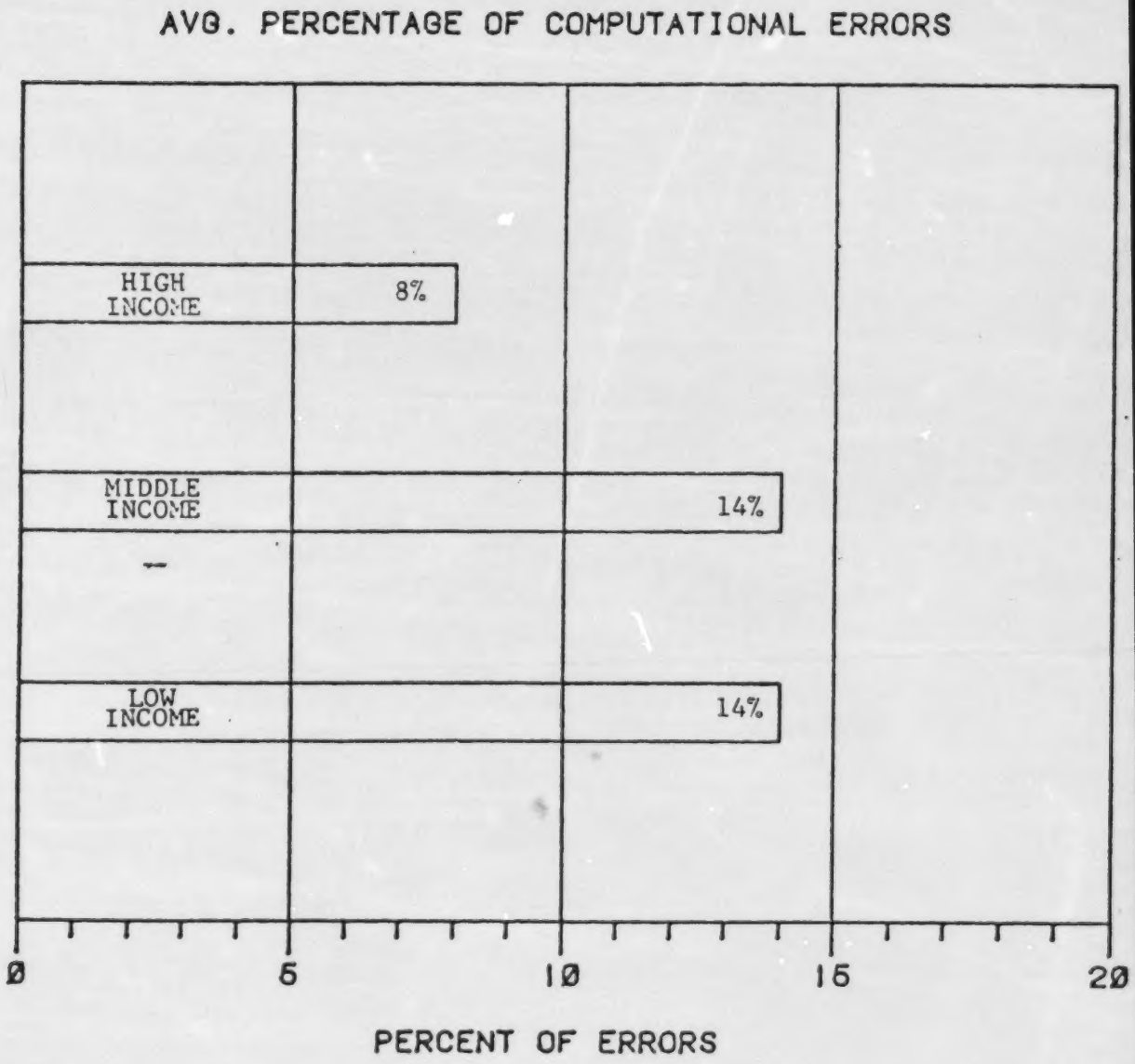


TABLE 5

20 VERBAL WORD PROBLEM TEST RESULTS

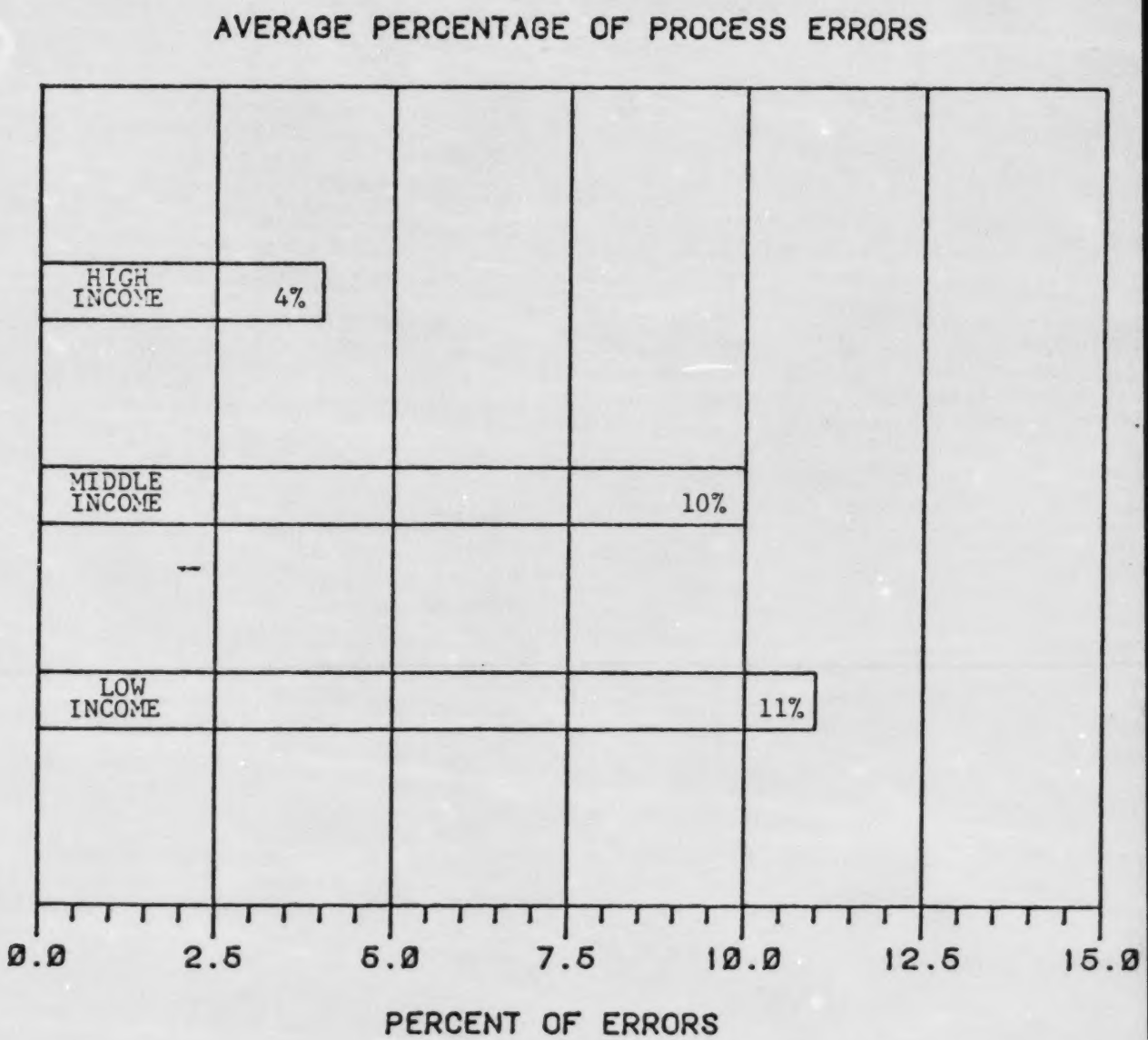


TABLE 6

20 VERBAL WORD PROBLEM TEST RESULTS

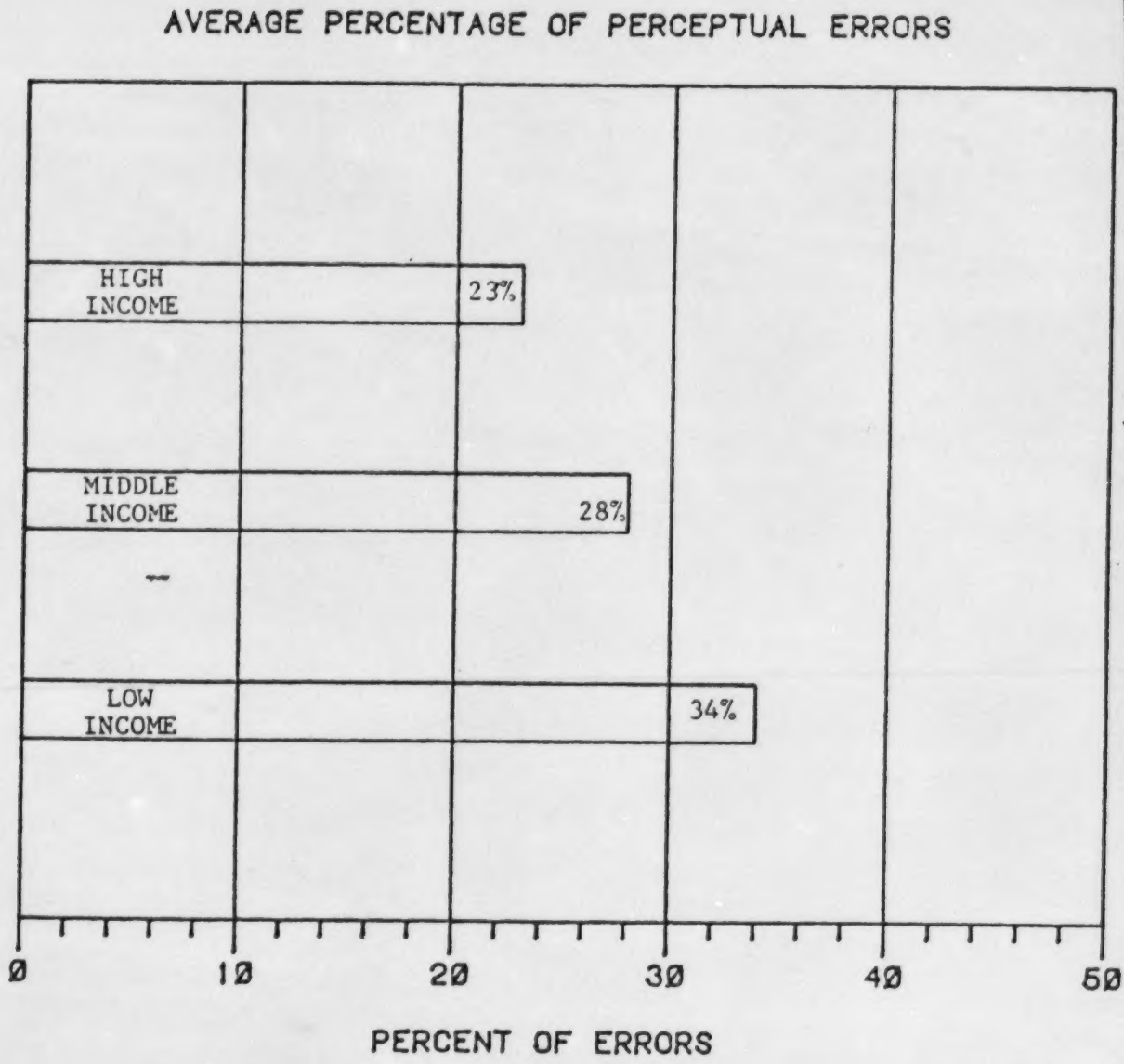
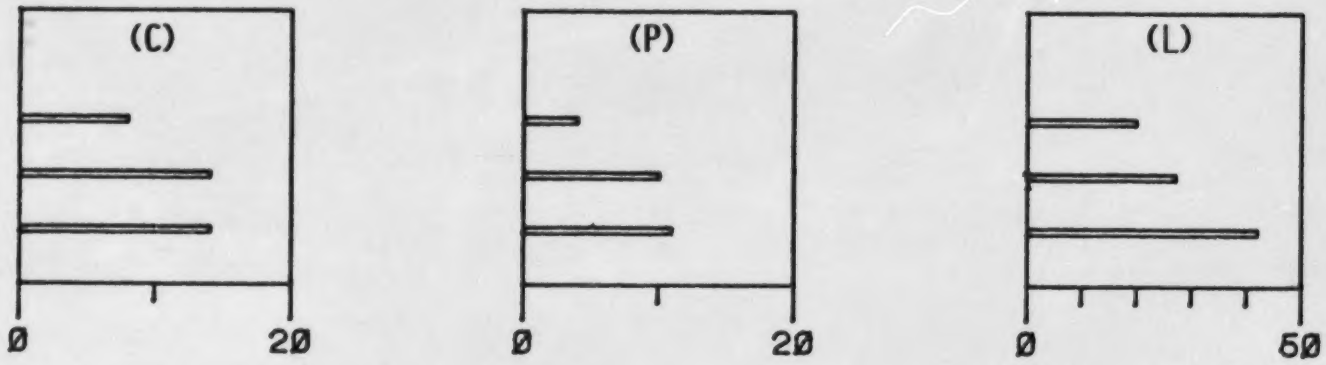


TABLE 7

(COMPOSITE OF TABLES 2 - 6)

20 VERBAL WORD PROBLEM TEST RESULTS

AVG. COMPUTATION PROCESS LABELING ERRORS



AVERAGE NUMBER ORDER & PERCEPTUAL ERRORS

TABLE 9

TOTAL COMPUTATIONAL, PROCESS, AND LABELING ERRORS
ON THE 20 WORD-PROBLEM PRE-TEST
BY PUPILS FROM MIDDLE SOCIO-ECONOMIC SCHOOLS

PROBLEM #	TOTAL C ERRORS	TOTAL P ERRORS	TOTAL L ERRORS
1	6	7	12
2	7	9	24
3	10	13	17
4	47	24	43
5	18	21	27
6	19	68	89
7	16	13	30
8	25	21	40
9	122	54	209
10	28	59	204
11	18	27	76
12	70	38	105
13	27	25	85
14	122	40	112
15	16	12	44
16	17	3	40
17	27	45	31
18	37	9	42
19	24	20	69
20	94	69	84
	755	577	1383

DATE 092

TABLE 10

TOTAL COMPUTATIONAL, PROCESS, AND LABELING ERRORS
ON THE 20 WORD-PROBLEM PRE-TEST
BY PUPILS FROM LOW SOCIO-ECONOMIC SCHOOLS

PROBLEM #	TOTAL C ERRORS	TOTAL P ERRORS	TOTAL L ERRORS
1	9	3	60
2	7	22	70
3	8	13	60
4	49	38	80
5	9	22	78
6	21	58	118
7	21	9	79
8	24	14	91
9	130	77	246
10	46	66	249
11	24	14	119
12	68	57	162
13	26	23	120
14	121	72	167
15	20	4	98
16	31	2	91
17	32	28	93
18	40	6	97
19	29	11	98
20	90	81	107
	805	620	2283

WORD PROBLEM #15 TESTED THE SKILL OF ADDITION - 3 OR 4 NUMBERS - SUMS LESS THAN 18. THERE WERE MANY ERRORS OF OMISSION, WHERE THE STUDENT CHOSE TO CALCULATE 2 OF THE 3 NUMBERS, AT RANDOM - AND OMITTED THE THIRD NUMBER ENTIRELY. SOME OF THE COMBINATIONS WERE 4+3, 5+4, AND 5+3. THESE OMISSIONS WERE PERCEIVED AS PERCEPTUAL ERRORS. THEREFORE, IN DESIGNING THE ADDITION AND SUBTRACTION VERBAL WORD PROBLEM WORKBOOK, THE WRITER HIGHLIGHTED THE NUMBERS IN THE WORD PROBLEMS.

WORD PROBLEMS #17 AND #18 TESTED THE SKILLS OF ADDITION - 2 DIGITS AND 1 DIGIT - REGROUPING, AND ADDITION - 2 DIGITS AND 2 DIGITS - REGROUPING. FEWER THAN 3% OF ALL THE STUDENTS TESTED MADE A PROCESS ERROR ON WORD PROBLEM #18 (2 DIGITS AND 2 DIGITS - REGROUPING). HOWEVER, 13% OF ALL THE STUDENTS MADE A PROCESS ERROR IN COMPUTING WORD PROBLEM #17 (2 DIGITS AND 1 DIGIT - REGROUPING), WHICH STATED: "HIS FATHER GAVE HIM 6 MORE CHICKS." THIS RESPONSE SUGGESTS THAT SOME TEACHERS MAY BE ARBITRARILY TEACHING STUDENTS TO SUBTRACT WHEN THEY SEE THE WORK "MORE" IN A WORD PROBLEM, INSTEAD OF INTERPRETING THE WORD IN CONTEXT.

THE RESULTS OF THIS PRACTICUM, AS THEY RELATE TO THE EXPECTED BEHAVIORS ON PAGE 20, ARE DISCUSSED BELOW.

1. THIRD GRADE WORD PROBLEM TEST AND CLASSROOM PROFILE - CLASSROOM TEACHER EVALUATION

THE THIRD GRADE WORD PROBLEM TEST WAS ADMINISTERED BY EACH OF THE 41 CLASSROOM TEACHERS TO THEIR THIRD GRADE CLASSES. SCORING OF THE TEST WAS DONE BY THE WRITER.

THREE TYPES OF ERRORS WERE TALLIED AND RECORDED FOR EVERY STUDENT ON EACH OF THE 41 CLASSROOM PROFILES:

(1) C = COMPUTATIONAL ERROR
(2) P = PROCESS ERROR
(3) L = LABELING ERROR.

ALL 41 TEACHERS RECEIVED A CLASSROOM PROFILE (SEE APPENDIX 13) OF THEIR STUDENTS' RESPONSES ON THE 20 WORD PROBLEM TEST, WHICH PINPOINTED AREAS OF STRENGTH AND WEAKNESS IN EACH OF THE 20 ADDITION AND SUBTRACTION MATH SKILLS. ATTACHED TO EACH CLASSROOM PROFILE WAS A CLASSROOM TEACHER EVALUATION FORM (SEE APPENDIX 18).

SEVENTY-THREE PERCENT OF THE THIRD GRADE CLASSROOM TEACHERS RESPONDED TO THE SURVEY. NINETY - ONE HUNDRED PERCENT OF THE RESPONDENTS INDICATED AN AWARENESS AND NEED FOR EACH OF THE FIVE ITEMS LISTED ON THE EVALUATION FORM. SEVERAL TEACHERS IN THE HIGH SOCIO-ECONOMIC GROUP APPEARED TO HAVE LESS OF A NEED FOR REENFORCEMENT OF THESE FIVE ITEMS THAN TEACHERS OF THE MIDDLE AND LOW INCOME GROUPS.

SOME TEACHERS COMMENTED:

(1) "CLEAR AND EASY-TO-READ PROBLEMS."

(2) "FORMAT MADE PROCESSES EASIER TO WORK."

(3) "EMPHASIS ON LABELING WAS HELPFUL, AS IT IS A FREQUENTLY IGNORED BUT MUCH NEEDED SKILL FOR CHILDREN AT THIS LEVEL."

BECAUSE MORE THAN 80% OF THE RESPONDENTS REPORTED HAVING GREATER AWARENESS OF THE IMPORTANCE OF IMPROVING PROBLEM-SOLVING SKILLS AS WELL AS COMPUTATIONAL COMPETENCIES, THE SECONDARY GOAL OF THIS PRACTICUM WAS MET.

2. THIRD GRADE ADDITION AND SUBTRACTION WORD PROBLEM WORKBOOK PROGRAM - CLASSROOM TEACHER EVALUATION

AFTER A FOUR-MONTH IMPLEMENTATION PERIOD OF THE THIRD GRADE ADDITION AND SUBTRACTION WORD PROBLEM WORKBOOK, THE THREE THIRD GRADE CLASSROOM TEACHERS IN THE EXPERIMENTAL GROUP AT SOUTH MIAMI HEIGHTS ELEMENTARY SCHOOL WERE ASKED TO EVALUATE THE WORKBOOK PROGRAM (SEE APPENDIX 19).

THE THREE CLASSROOM TEACHERS CHECKED MODERATELY, QUITE A BIT, AND EXTREMELY ON 95% OF THE 7 ITEMS CLASSROOM TEACHER EVALUATION FORM. SOME OF THE COMMENTS WERE: (SEE APPENDIX 24)

(1) "THE LARGE TYPE WAS EASY TO READ AND THE FORMAT WITH THE LARGE CIRCLES, ETC. WAS EXCELLENT."

(2) "MY CLASS ENJOYED READING THE STORY PROBLEMS."

(3) "THE ONGOING REENFORCEMENT OF READING AND SOLVING MATHEMATICAL WORD PROBLEMS HAS BEEN QUITE ADVANTAGEOUS TO THE CHILDREN. THE REWARD SYSTEM INVOLVED WITH THE WORD PROBLEM CONTEST (SEE APPENDIX 20) ALSO MOTIVATED THE CHILDREN TO EXCEL. THEY LOOKED FORWARD TO THE WORKSHEETS THEMSELVES, AND IN THE FINAL EVENT, THEIR CHARTED PROGRESS."

Because more than 50% of the responses were positive, the criterion for success was achieved for the Classroom Teacher Evaluation of the Workbook Program.

3. Third Grade Addition and Subtraction Word Problem Workbook - Pupil Evaluation

After the four-month-long implementation of the Word Problem Workbook, 78 pupils in the three Experimental Third Grade Classes were asked to evaluate the workbook (see Appendix 21).

The same Forced-Choice format was used on the Pupil Evaluation Form as was used in the Word Problem Workbook. The students were given verbal instructions by the Writer to color in only ONE circle for each item, except for item 7, which required TWO colored circles. The Writer was not present in any of the 3 classrooms when the evaluations took place.

Ninety-one percent of the pupils in the Experimental Group colored in the circle preceding "I liked the stories."

Ninety-one percent colored in the circle preceding "The words in the stories were easy to read."

Seventy-one percent colored in the circle preceding "I would like to do more of these problem-solving workpages in Fourth Grade.

Seventy-eight percent of the comments on item #8 were positive, 12% were negative, 8% made no comment, and 2% made both positive and negative comments (see Appendix 25).

The positive comments included:

"Wish we had it every day."
"Like the story and the problems."
"Grate!"
"They need more pages."
"Nice!"
"Fun!"
"Cool!"
"You are one hek of a lady!"

Some negative comments were:

"Probably too much work."

"Would not like to do anymore."

"Tired of doing them."

There were more than 70% positive Pupil Evaluations of the Workbook Program - therefore, the criterion for success was achieved for this goal.

4. Pre and Post Test Results of the 20 Verbal Word Problem Test (after the four month implementation of the Third Grade Word Problem Workbook Program)

Pre and Post Test results of the average percentage of Number Order and Labeling errors are illustrated in the accompanying bar graphs for both the Experimental and Control Groups.

On the Post Test, the Experimental Group scored a 16% decrease in the average percent of Subtrahend-Minuend Number Order errors made on the Pre Test (for Problems #9 and #20), whereas the Control Group decreased their errors by only 5% (Table 11).

Similarly, on the Post Test, the Experimental Group averaged a 27% decrease in percent of Labeling errors made on the Pre-Test, whereas the Control Group decreased their errors only 10% (Table 12).

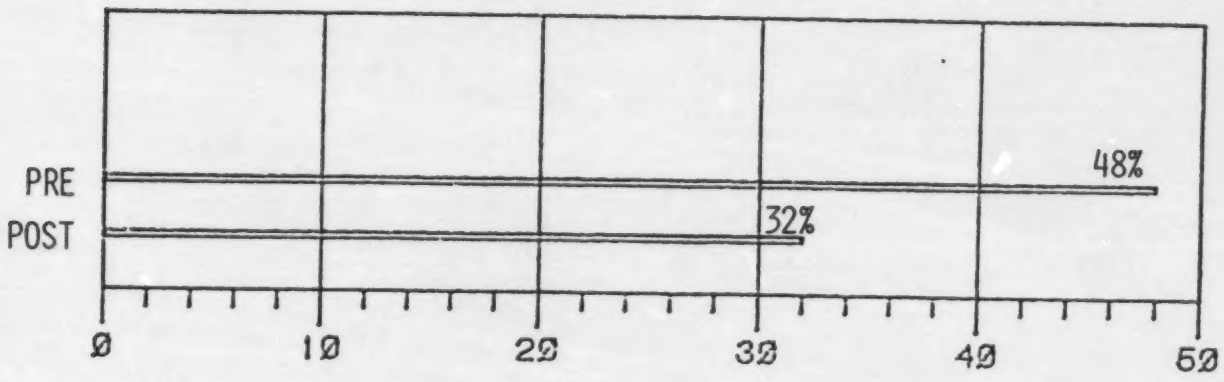
The standard for success was achieved for the following skill areas:

1. Subtrahend-Minuend Number Order in Word Problems - a 16% average decrease in the number of errors (criterion for success was 15%).
2. Labeling of numerical answers to word problems - a 27% decrease in the number of labeling errors (criterion for success was 25%).

TABLE 11

AVERAGE NUMBER ORDER ERRORS

PRE & POST TEST RESULTS - EXPER. GROUP (N = 67)



PRE & POST TEST RESULTS - CONTROL GROUP (N = 48)

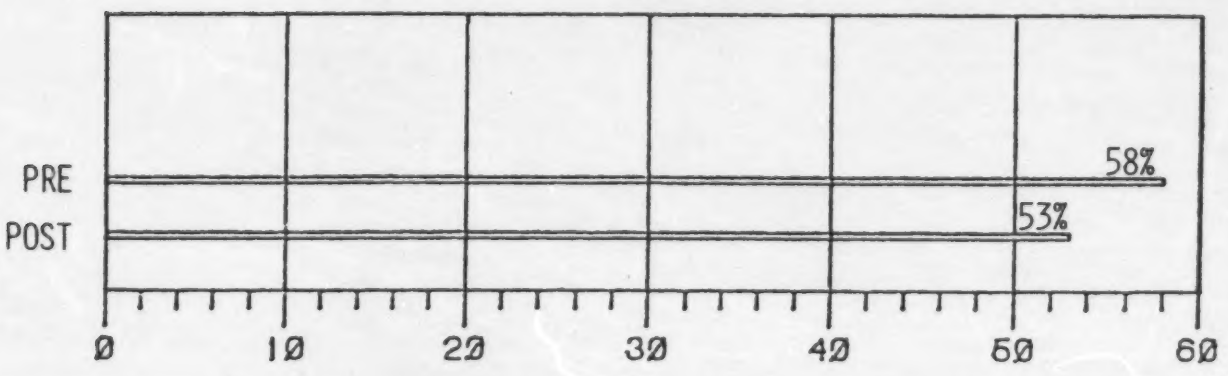
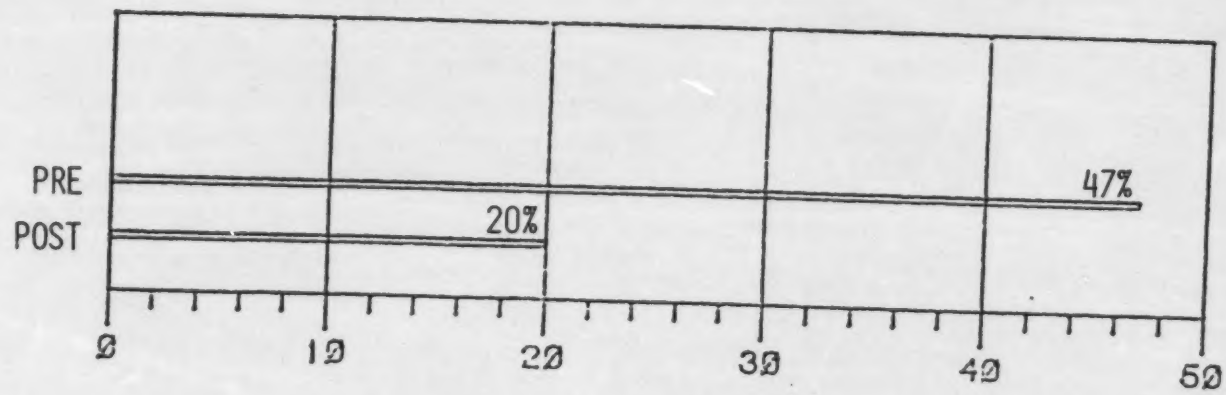


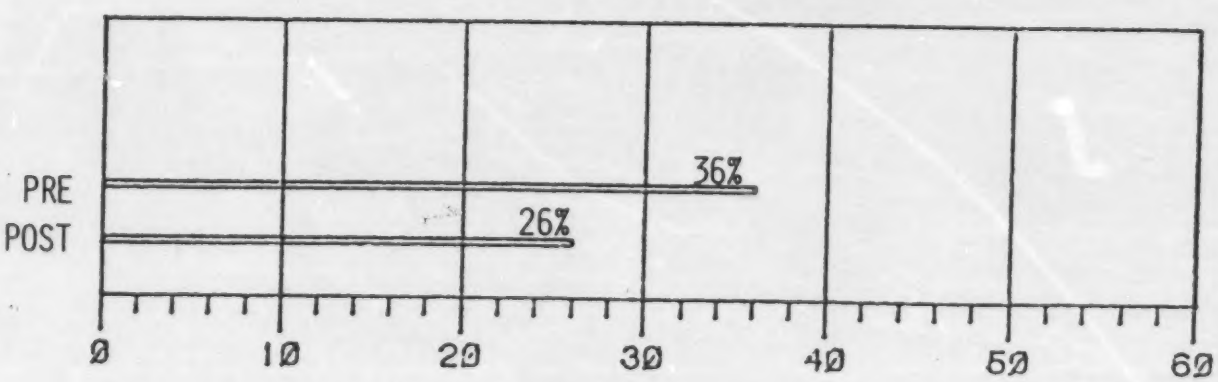
TABLE 12

AVERAGE LABELING ERRORS

PRE & POST TEST RESULTS - EXPER. GROUP (N = 67



PRE & POST TEST RESULTS - CONTROL GROUP (N = 48)



STATISTICAL ANALYSIS OF THE DATA SHOWS THAT APPROXIMATELY EQUAL NUMBERS OF MALES AND FEMALES PARTICIPATED IN THE STUDY (396 AND 422, RESPECTIVELY). BASED ON ECONOMIC LEVEL, THE SAMPLE WAS REPRESENTED AS FOLLOWS: HIGH INCOME, N = 320 (37.7%); MIDDLE INCOME, N = 254 (29.9%); AND LOW INCOME, N = 273 (32.2%). THUS ALL GROUPS (GENDER AND INCOME) WERE REPRESENTED IN A RELATIVELY EQUAL MANNER (I.E., NO GROUP WAS OVER- OR UNDER-REPRESENTED).

CORRELATIONAL ANALYSES REVEALED THAT INCOME WAS HIGHLY CORRELATED WITH COMPUTATION, PROCESS, LABELING AND NUMBER ORDER ERRORS (ALL SIGNIFICANT AT THE .000001 LEVEL), BUT INCOME DID NOT CORRELATE WITH PERCEPTUAL ERRORS. THUS, AS INCOME LEVEL INCREASES, THE NUMBER OF ERRORS MADE IN THESE FOUR GROUPS (COMPUTATION, PROCESS, LABELING, NUMBER ORDER) DECREASES (I.E., CHILDREN IN THE HIGH INCOME GROUP MADE FEWER MISTAKES THAN THOSE IN THE MIDDLE INCOME GROUP WHO, IN TURN, PERFORMED BETTER THAN THE LOW INCOME CHILDREN).

SEVERAL TYPES OF ERRORS WERE CORRELATED HIGHLY WITH EACH OTHER (.00001 SIGNIFICANCE LEVEL). THE FOLLOWING SHOWED HIGH CORRELATIONS: COMPUTATION ERRORS WITH PROCESS AND PERCEPTUAL ERRORS; PROCESS WITH LABELING AND PERCEPTUAL ERRORS. A WEAKER CORRELATION WAS FOUND BETWEEN LABELING AND PERCEPTUAL ERRORS (.0008). THUS, THESE TYPES OF ERRORS SEEM TO OCCUR TOGETHER IN A SYSTEMATIC FASHION. NO CORRELATION WAS FOUND FOR NUMBER ORDER ERRORS WITH ANY OF THE OTHER TYPES OF ERRORS. IT APPEARS THAT NUMBER ORDER ERRORS OCCUR IN A RANDOM FASHION RATHER THAN IN TANDEM WITH ANY OTHER TYPE OF ERROR.

A more in-depth Analysis of Variance reveals how each of the three Socio-economic groups differed from one another on Types of Errors when analyzed by Income group and Gender. No differences were found for Gender. However, Income differences were found for all Types of Errors except Perceptual; all groups performed equally on this particular Type of Error. On Computation errors, High Income children made significantly fewer errors than did Middle or Low Income children (means of 1.76, 3.02, and 3.21, respectively). Middle and Low Income children did not differ significantly from each other. A similar relationship was seen for Process errors (means of .98, 2.26, and 2.48, from High to Low, respectively). For Labeling and Number Order errors, Low Income children made significantly more errors than either Middle or High Income children (who did not differ significantly from each other). Means for Labeling errors, from Low to High Income, were 9.38, 5.43, and 5.82. For Number Order errors, Low Income children had a higher mean, whereas Middle and High Income children showed lower means on this type of error (see Table 2). No significant differences were found for Perceptual Errors (from Low to High, .41, .37, and .35). Again, this type of error has no relationship to Income group and appears to be distributed evenly across all groups.

No main effects or interactions were found for Type of Error, Income, and Gender. Incidentally, since no Gender differences were found between males and females on Number or Types of Errors, it can be surmised that the better math performance in males theorized in later years has not yet manifested itself.

B. Conclusions

It is the Writer's opinion that:

(1) Labeling errors are more amenable to remediation over a short period of time (four months) than Number Order errors. Greater gains in Number Order proficiency would be expected after a longer implementation period, such as an entire school year.

(2) This Workbook Program would have greater impact on students and teachers if it were implemented in the Fall Semester of the school year. The second semester, January through June, could be utilized for remediation of the deficit areas pinpointed in the Class Profile of the 20 Verbal Word Problem Test. Pre and Post Testing with this test can be viewed as a clinical-diagnostic approach to math problem-solving instruction in the elementary schools.

This practicum achieved its Primary goal of improving and increasing the problem-solving skills of Third Grade children in South Miami Heights Elementary School. The additional expectations were also met: Third Grade teachers and their students showed a positive attitude toward the Writer's systematic procedures for improving young children's problem-solving competencies.

The Addition and Subtraction Word Problem Workbook met a definite need in the Third Grade curriculum, based on the positive evaluations by both teachers and students.

This workbook has application potential for advanced first and second graders at the lower end, and fourth and fifth graders at the higher end of the elementary school population, as well as children with learning disabilities.

C. RECOMMENDATIONS

IT IS SUGGESTED THAT CLASSROOM TEACHERS AND PUBLISHERS OF MATH TEXTBOOKS, WORKBOOKS, AND OTHER RELATED MATERIALS, TAKE THESE RESEARCH FINDINGS INTO ACCOUNT, AS THEY APPLY TO STUDENTS, BEGINNING AS EARLY AS FIRST GRADE:

(1) THE "ORDER OF MENTION" OF NUMBERS IN SUBTRACTION WORD PROBLEMS SHOULD APPROXIMATE THE FOLLOWING FORMAT:
ONE HALF OF THE NUMBER OF SUBTRACTION WORD PROBLEMS SHOULD BE WORDED WITH THE SMALLER NUMBER (SUBTRAHEND) FIRST, FOLLOWED BY THE LARGER NUMBER (MINUEND).
ONE HALF OF THE NUMBER OF SUBTRACTION WORD PROBLEMS SHOULD BE WORDED WITH THE LARGER NUMBER FIRST, FOLLOWED BY THE SMALLER NUMBER.

(2) PROVISIONS SHOULD BE MADE IN TEXTBOOKS AND WORKBOOKS FOR ADDITIONAL REENFORCEMENT OF LABELING SKILLS.
THESE MODIFICATIONS MIGHT ENCOURAGE YOUNG CHILDREN TO ANALYZE THE DATA IN WORD PROBLEMS, AND SO HELP IN THE DEVELOPMENT OF CRITICAL THINKING SKILLS.

(3) A CONTROLLED VOCABULARY IN WRITTEN VERBAL WORD PROBLEMS IS RECOMMENDED AT ALL GRADE LEVELS IN THE ELEMENTARY SCHOOL. STUDENTS' PREOCCUPATION WITH DECODING WORDS OFTEN INTERFERES WITH THEIR ABILITY TO SOLVE WORD PROBLEMS SUCCESSFULLY.

(4) CLASSROOM TEACHERS SHOULD PROVIDE FOR ADDITIONAL REENFORCEMENT OF SUBTRACTION SKILLS AT ALL GRADE LEVELS. IN THE INTERMEDIATE GRADES, SUCCESSFUL MULTIPLICATION AND DIVISION COMPUTATIONS ARE DEPENDENT UPON PRIOR MASTERY OF ADDITION AND SUBTRACTION SKILLS.

(5) BEGINNING IN GRADE 1, CLASSROOM TEACHERS MUST INSIST THAT EVERY NUMBER ANSWER TO A WRITTEN VERBAL WORD PROBLEM BE ACCOMPANIED BY A LABEL IN THE FORM OF A WORD OR A SYMBOL. IF THIS PRACTICE IS IMPLEMENTED IN THE EARLY GRADES, THE CHILD MAY BE "PROGRAMMED" TO USE ANALYTICAL AND CRITICAL THINKING SKILLS, TO HELP IMPROVE HIS ABILITY TO SOLVE WORD PROBLEMS.

(6) RESULTS OF THIS PRACTICUM SUGGEST:

A. FURTHER RESEARCH TO INVESTIGATE THE CORRELATION BETWEEN SOCIO-ECONOMIC STATUS AND THE SPECIFIC SKILLS NECESSARY FOR THE SUCCESSFUL SOLUTION OF WRITTEN VERBAL WORD PROBLEMS.

B. ADDITIONAL RESEARCH TO MATCH INSTRUCTIONAL STRATEGIES WITH INDIVIDUAL STUDENT LEARNING STYLES, TO HELP PUPILS SOLVE WRITTEN VERBAL WORD PROBLEMS.

D. DISSEMINATION

1. ALL 41 THIRD GRADE CLASSROOM TEACHERS IN THE FOUR COUNTIES IN THE STATE OF FLORIDA, WHO PARTICIPATED IN THE TESTING PROGRAM, HAVE COPIES OF THE 20 WRITTEN VERBAL WORD PROBLEM TEST IN ADDITION AND SUBTRACTION, WHICH THEY PLAN TO USE AT THE BEGINNING OF THE SCHOOL YEAR AS A DIAGNOSTIC INSTRUMENT.

2. SAMPLE WORKPAGES OF THE ADDITION AND SUBTRACTION WORD PROBLEM WORKBOOK FOR THE PRIMARY GRADES HAVE BEEN SENT TO EIGHT PUBLISHERS FOR REVIEW (SEE APPENDIX 22).
   MAFEX ASSOCIATES, INC., PUBLISHERS (MATERIALS FOR THE EXCEPTIONAL) HAVE RESPONDED IN A POSITIVE MANNER AND ARE INTERESTED IN SEEING THE ENTIRE PROGRAM FOR EVALUATION (SEE APPENDIX 23).

3. A JOURNAL ARTICLE WILL BE WRITTEN, DISCUSSING THE RESULTS OF THIS EXTENSIVE PREASSESSMENT OF THIRD GRADE PROBLEM-SOLVING SKILLS.

4. AN ABSTRACT OF THIS PRACTICUM WILL BE SUBMITTED TO ERIC FOR PUBLICATION AND DISSEMINATION.

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